Staff Report

Water Quality
IN SAN FRANCISCO BAY

January 1987

San Francisco Bay Conservation and Development Commission

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on

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San Francisco Bay Conservation and Development Commission
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INTRODUCTION

San Francisco Bay is well known as one of the world's great natural harbors and as the setting for a flourishing urban center. In addition, the mixing of the Pacific Ocean and the fresh waters of the Sacramento and San Joaquin Rivers within the Bay creates the largest estuarine system in California. Estuaries provide abundant habitat and breeding grounds for fish and wildlife, and San Francisco Bay is no exception. The Bay not only provides extensive habitat for resident fish and wildlife, but is also an important resource for many species of migratory fish, waterfowl, and shorebirds. Moreover, the San Francisco Bay estuary provides residents and visitors with substantial economic, recreational, and aesthetic benefits. As an economic resource, the Bay affords secure and spacious deep water ports, commercial and sport fisheries, areas for the production of salt, numerous tourist attractions, and cooling waters for industry. It also provides recreational and aesthetic values for boaters, swimmers, fisherman, hikers and all those who appreciate its natural beauty and moderating effect on the climate. The many benefits that the San Francisco Bay provides make it a resource of inestimable value.

All uses of the Bay depend to a greater or lesser extent on the quality of its waters. While many uses coexist with and enhance one another, others may conflict or degrade the value of the Bay. A leading cause of degradation and a fundamental threat to the future benefits of the Bay is the contamination of its waters by pollutants.

Water pollution can render human water contact recreation hazardous, harm or destroy Bay organisms, degrade sport and commercial fisheries, and

even preclude use of Bay water by industry. Consequently, preventing or controlling water pollution is crucial to obtaining full benefit from the Bay's many uses. But the San Francisco Bay system has been extensively altered by human activity, resulting in significant effects on Bay water quality, which, in turn, have had major impacts on the Bay's beneficial uses. The most important of these changes include: (1) increased discharges of pollutants, (2) reduction in the Bay's surface area and volume through filling and diking, and (3) reduction in the Bay's fresh water inflow. While some of the most dramatic changes occurred long ago, their legacy, in conjunction with our present activities, still threatens the health of the Bay.

Historical Bay Conditions

Although the Bay has received human wastes since the earliest settlements, it was during the Gold Rush that the scale of human activities began to have significant affects on the Bay. In just the two years between 1847 and 1849, San Francisco's growth boomed from 375 to 25,000, and many new settlements sprang up around the Bay. Raw sewage generated by the burgeoning population was soon entering the Bay in sufficient quantities to affect water quality, prompting the State Board of Fish Examiners in 1879 to identify "...the fetid inpourings of our sewers..." as damaging to the Bay fishery.

The Gold Rush also brought hydraulic mining to the Sierra Nevada, beginning around 1850, with far reaching effects on the San Francisco Bay and its tributaries. Hydraulic mining introduced massive amounts of sediments into the Sacramento-San Joaquin water system that quickly began choking watercourses, impeding navigation, exacerbating flooding, and decimating fisheries. A substantial portion of this sediment accumulated in the San Francisco Bay and Delta; over a billion cubic yards of material were deposited

in the Bay during the main period of siltation from hydraulic mining (1849 to 1914).[1/] This massive load of sediment permanently reduced the open water area and volume of the Bay. The effect on human activities caused by hydraulic mining's environmental destruction, led to its banning by court order in 1884.

New residents quickly began filling and diking the Bay and its surrounding wetlands as well as diverting its inflowing freshwater for agricultural, residential, and industrial uses. Today, approximately 40 percent of the Bay's pre-Gold Rush surface area has been diked or filled and only about 75 square miles of its surrounding marshlands remain from the 300 square miles that existed prior to the Gold Rush. Freshwater inflow to the Bay has been reduced to 40 percent of pre-gold rush levels and proliferating upstream discharges have added increasing amounts of pollutants to the remaining freshwater inflow.

While filling, diking, and diversions reduced the Bay's ability to assimilate pollutants, the inflow of raw or poorly-treated sewage, industrial wastes, and polluted runoff increased as a consequence of intensifying urbanization and industrialization in the Bay Area. By the 1950's this burden of pollution was causing gross bacterial contamination of the Bay and was the suspected cause of fish kills[2/] and the stench of decay that often clothed the Eastbay's mudflats.

Passage of state and federal pollution laws in the late 1940's signaled an end to raw sewage discharges in the Bay and resulted in the construction of sewage treatment plants. State and Regional Water Quality Control Boards were also established at this time to administer the California water pollution control program. However, while greatly improved, Bay water quality remained unacceptable; as late as 1964, indicators of pathogen levels in the central

Bay were still three to ten times the levels considered safe for human water contact.[3/] Subsequent state and federal legislation, notably the state Porter-Cologne Act of 1969, its amendments, and the federal Clean Water Act amendments of 1972, toughened water pollution control laws to require more stringent treatment of wastes, and provided funding for the major research and public works programs needed to implement these laws. Establishment of the Bay Commission in 1965 effectively halted the uncontrolled filling of the Bay.

Today, the San Francisco Bay Regional Water Quality Control Board (Regional Board) administers the water quality regulatory program in the Bay Area, overseen by the State Water Resources Control Board (State Board), and, at the federal level, by the Environmental Protection Agency (EPA). The State Board also regulates diversion of freshwater from tributaries to the Bay. The Regional Board has identified the beneficial uses of the Bay, including natural and aesthetic uses, and implements programs to protect these uses.

The regulation of discharges and close to 3 billion dollars invested in sewage treatment facilities, mandated by state and federal water pollution control programs, have dramatically reduced many sources of pollution to the Bay. The gross bacterial pollution of the Bay, widespread in the 1950's, has all but disappeared. Water quality has now improved sufficiently to allow safe water contact recreation in most parts of the Bay and to allow some recreational harvesting of shellfish.

Unfortunately, though many battles against pollution have been won, the war has yet to be decided and, perhaps, may never be. Parts of the Bay, such as the extreme South Bay, still suffer from poor water quality, while periodic wet weather overflows and treatment plant failures intermittently discharge inadequately treated sewage. As the costs of further improvements in wastewater treatment rise, the costs of achieving presently mandated levels of

treatment are straining the resources of government agencies. Meanwhile, increases in wastes from an expanding population work against improvements in waste treatment. Further, the Bay's ability to disperse and neutralize wastes would be diminished by proposed diversions of fresh water inflow and filling of Bay waters and wetlands. Finally, as manufacture and use of hazardous chemicals proliferates, the productive Bay estuary must be protected from the toxic pollution threat posed by these chemicals.

It is evident that improving and maintaining the quality of the Bay's waters in the years ahead will be a heavy challenge, but it is a challenge that must be, and is being, met. For example, the Regional Board's latest amendments to its water pollution control plan will further improve that agencies vigorous efforts to protect the Bay's beneficial uses, such as including stricter controls on toxic substances and expanding control of polluted urban runoff.

The Bay Commission's Role in Water Quality

The Commission has an important role to play in maintaining and improving the quality of the Bay's waters. Through permit conditions that protect water quality, by working with the State and Regional Boards and other agencies to protect and improve water quality, and, most importantly, by preserving the Bay's natural flushing and cleansing abilities through maximizing the surface area and volume of the Bay and its surrounding wetlands; the Commission can help preserve the value of our greatest regional resource, the Bay.

In its San Francisco Bay Plan (page 2), the Commission has emphasized the importance of water quality to the Bay's future: "[T]he entire Bay Plan is founded on the belief that water quality in San Francisco Bay can and will

be maintained at levels sufficiently high to permit full public enjoyment and use of the Bay."

The Bay Plan includes findings and policies that specifically address water pollution in the Bay and provide for maintaining high Bay water quality. However, these findings and policies have not been revised since the adoption of the Bay Plan in 1969. Important strides have been made in the interim, in understanding Bay water pollution, in improving state and federal water pollution control programs, and in constructing pollution control facilities. Additionally, the effects of toxic pollutants in the Bay have become a growing concern, due in part to their persistent nature and the lack of sufficient information to predict their impact on the Bay. These factors, together with increasing Bay Area urbanization and shifts in Bay industries, have altered significantly both Bay water quality and the priorities for its improvement.

This report identifies and discusses pollutant problems in San Francisco Bay, the regulatory framework for pollution control, and the Commission's involvement in water quality regulation. It also recommends changes to the Commission's Bay Plan findings and policies relating to Bay water quality. Chapter I discusses the Bay system in relation to water quality, identifies the major pollutants of concern to Bay water quality, and discusses the effects of these pollutants on Bay organisms. Chapter II identifies the sources of Bay pollutants and methods to control them. Chapter III delineates the regulatory authority and framework to control Bay water pollution. Chapter IV discusses the Commission's involvement in pollution control and suggests new findings and policies on water quality for possible adoption by the Commission.

CHAPTER I. BAY POLLUTION PROBLEMS

Much of the difficulty of finding solutions to water pollution problems in San Francisco Bay is due to the complexity of the Bay estuarine system and the many kinds of pollutants that it receives. This chapter gives an overview of estuarine processes relating to water quality and the major categories of Bay pollutants. The first part of the chapter identifies those physical aspects of the Bay that most affect water quality, such as tidal action, freshwater inflow, and their effects on water quality. Next addressed are the effects of Bay organisms on water quality and, conversely, how water pollutants affect Bay organisms. Given this baseline information, the major categories of pollutants that are discharged to the Bay are identified and the chapter concludes with further discussion of the effects of these pollutants on Bay organisms.

Certain terms used in this report, which may not be familiar to every reader, require explanation. Pollutants[1/] are substances that unreasonably impair the beneficial uses of the Bay. The "beneficial uses" of the Bay range from fish and wildlife habitat, aesthetic and recreational enjoyment, to industrial uses. Therefore, pollutants range from organic matter (that become pollutants when their concentrations impair beneficial uses), to toxic, persistent substances (like DDT). Pollutant-containing waters such as municipal sewage or industrial wastes, are referred to generically as "wastewaters." These wastewaters are discharged into "receiving waters" such as creeks, rivers, sloughs, or the Bay. These receiving waters may be partially "obstructed" or cut off from other parts of the Bay. The source of these discharges can be either "point" or "non-point" discharges. Point

sources are discharged at an identifiable place such as an industrial or municipal "outfall" pipe. Non-point sources are diffuse and thus are less directly attributable to a discrete source. Examples of non-point pollution include surface runoff and salt water intrusion. These terms will be used frequently in this chapter and in the remainder of the report.

Bay Physical Processes

The Bay is relatively shallow, averaging about twenty feet (six meters) in depth at low tide,[2/] but is cut with narrow channels averaging 33 to 66 feet (10 to 20 meters) in depth. Its two main arms or "reaches" can be further divided into several receiving water areas or "segments" as shown in Figure 1 (page 9). The northern reach extends from the Delta, where it receives the drainage of the Sacramento and San Joaquin Rivers, through Suisun and San Pablo Bays to the Central Bay and the Golden Gate. This freshwater inflow from the Delta has a dominating effect on water conditions in the northern reach. The Central Bay, being connected to the Pacific Ocean by the Golden Gate, is the most marine part of the Bay. The southern reach is partially cutoff from the Central and North Bays and receives little freshwater inflow. In fact, during summer the extreme South Bay receives more inflow from wastewater discharges than from river water.[3/]

1. Water Dispersion. Pollutants entering the Bay are dispersed by turbulent mixing and by circulation of Bay waters. Pollutants may then be (1) flushed out of the Bay, (2) eliminated through biological and physical processes, or (3) deposited in Bay sediments. Processes that control the speed at which Bay waters are dispersed (water dispersion rates) and flushed from the Bay include tidal action, freshwater inflow, and winds acting on the Bay's surface.

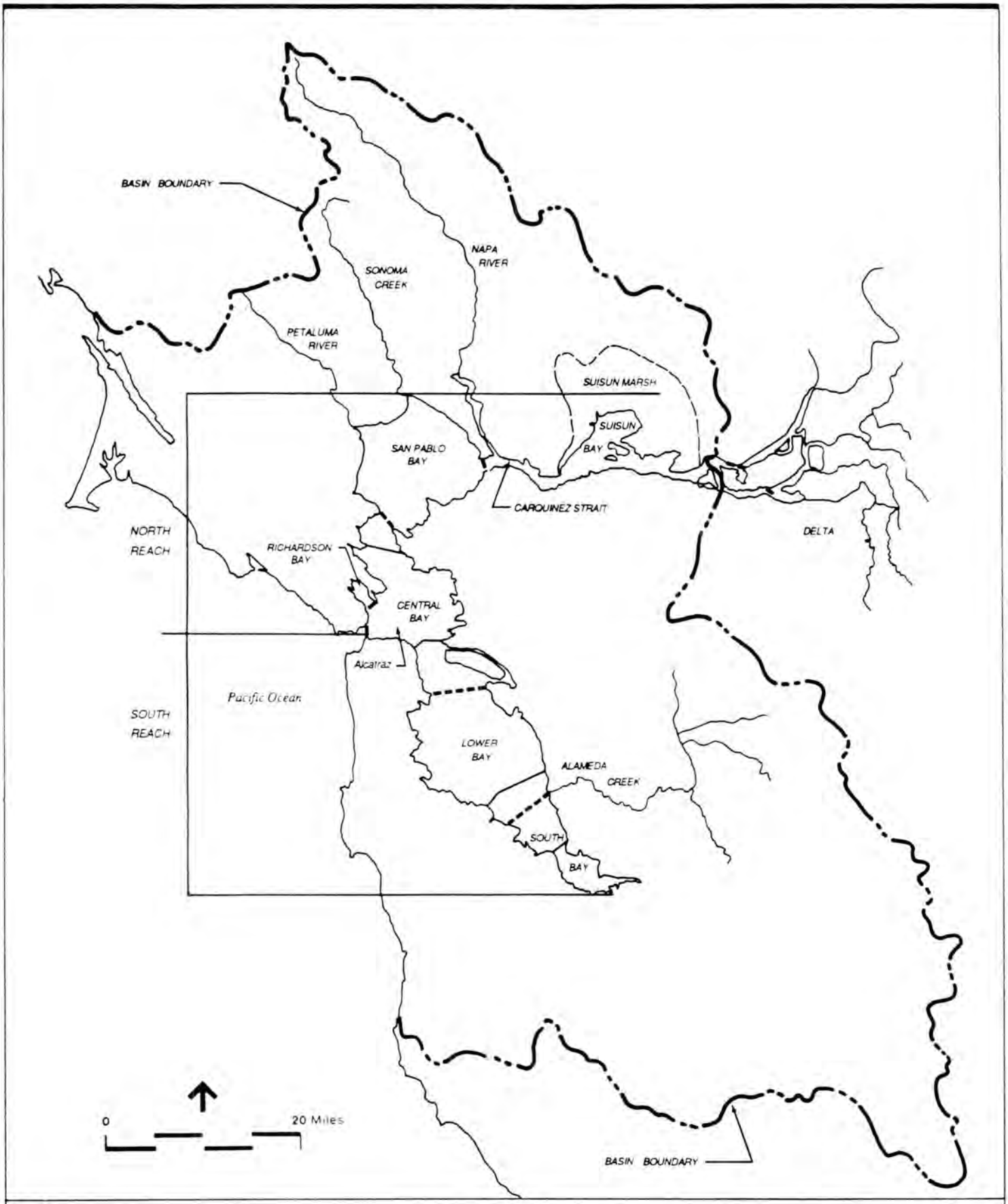


FIGURE 1

San Francisco Bay Basin Receiving Water Segments

a. Tidal Action. Tides profoundly affect water movement in the Bay and, while influenced by seasonal variations in wind and river inflow, the basic patterns of water flow that circulate and mix Bay waters are tidal. The ebb and flood of the tides, during an average tidal cycle, causes a water exchange with the coastal ocean about equal to a quarter of the Bay's low tide water volume.[4/] This body of water, defined as the difference between the low and high tide volume of the Bay, is the "tidal prism." However, the net amount of Bay water replaced in one full tidal cycle is actually much smaller than the tidal prism, averaging six percent of the Bay's volume,[5/] because about seventy-five percent of the outgoing tidal prism returns to the Bay on the following flood tide. Even so, tidal processes are highly important in dispersing and flushing Bay waters.

b. Freshwater Inflow. Freshwater flows to the Bay drain 40 percent of California's landmass and averaged 21 million acre feet per year over the period from 1921-1976.[6/] Because 90 percent of freshwater inflow comes through the Delta, its dispersive and flushing powers are concentrated in the northern reach of the Bay. Freshwater inflow rates vary seasonally in response to rainfall and snowmelt patterns and are greatest during winter and spring. Thus, while inflowing waters increase dispersion and flushing of waters in the northern reach year-round, it is during seasonal high flows that inflow dramatically increases dispersion and flushing processes in the entire Bay.

The meeting of the inflowing fresh river water with saline Bay waters creates an "estuarine current" (see Figure 2, page 11). This is because the river water, being less dense, flows over the top of the denser salt water before mixing. The salt water beneath the fresher water then moves upstream, due to differences in water density, creating a "circulation cell"

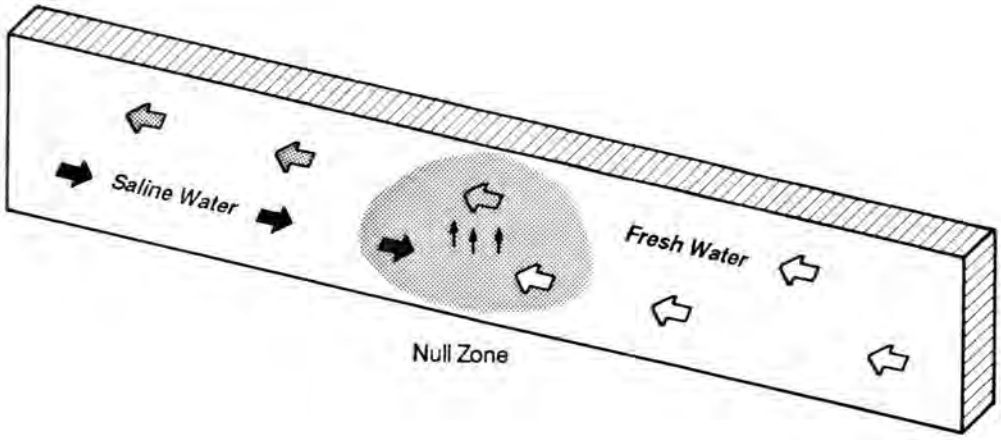


FIGURE 2
Estuarine Circulation and the Null Zone

that intensifies water, and, by inference, pollutant dispersion and flushing. It is important to note that the estuarine current carries ocean water into the Bay and moves Bay water upstream in the Bay, as well as carrying Bay and river water out of the Bay.

In high-flow periods the estuarine circulation cell extends to the entrance of the Golden Gate, and at times of highest flows will extend into the South Bay, flushing out pollutants and lowering the South Bay's salinity.

c. Wind Induced Water Movement. Wind action on the surface of the Bay promotes both turbulent mixing and circulation of its waters. Wind induced turbulence also resuspends sediments in the shallow parts of the Bay, increasing water turbidity.

2. Importance of Pollution Discharge Location. The impact of pollution discharges to any given part of the Bay depends on how long pollutants persist in the receiving waters, which, in turn, depends in part on the rates of water dispersion and flushing. These rates vary greatly both with location and time of year. The waters of the North and Central Bays, especially near main channels and the Golden Gate, disperse rapidly; an average particle of water resides in the North Bay for about two weeks in winter and two months in summer.[7/] Waters in such obstructed bays and marshes as Suisun Marsh, Richardson Bay, and the South Bay below the Dumbarton bridge disperse more slowly. A particle of water resides in the Lower and South Bays for about two months in the winter and about five months in summer.[8/] Pollutants that do not breakdown will tend to be retained longer, and thus may have more impact, in areas of slower dispersion, such as the South Bay.

3. Biological Processes. Circulating estuarine waters also have important effects on Bay organisms. Mixing of sediment-rich river water with marine salt water in estuarine systems supports richly productive plant and animal communities unique to estuaries. Additionally, the gradual mixing of Bay and river waters creates a gradient of salinity gentle enough to allow migratory fish such as salmon, to pass between the two water regimes.

The estuarine circulation system in the Bay's northern reach can act as a particle trap that may further enhance biological productivity. This occurs where the inland velocity of the salt water at the bottom of the estuary just equals the velocity of the inflowing fresh water and net upwelling occurs, in a region known as the "null zone" or "entrapment zone"(see Figure 2, page 11). As the fresh water enters the estuary and slows, sediments and algae settle from it into the salt water that is moving

freshwater, and thus are carried back up into the freshwater to repeat the process. The location of the null zone shifts in response to Delta flow rates and tidal currents. During typical summertime conditions, when the null zone is situated in proximity to the broad shallow embayments of Suisun Bay, then its trapping mechanism is thought to help maintain high phytoplankton levels and thus increase biological productivity in Suisun Bay.[9/]

In addition to functioning as a drainage system to dilute and flush pollutants out to sea, the Bay supports organisms that biologically assimilate and eliminate many pollutants, acting as a natural wastewater treatment plant. Bacteria serve as the principal decomposers of the Bay ecological system, consuming organic wastes and even breaking down certain toxic substances such as ammonia.

Marshes can also help cleanse wastewaters of certain pollutants.[10/] As polluted waters meander through a marsh, obstructions and changes in water salinity and velocity physically retain and settle pollutants. The high biological activity of the marsh community accelerates assimilation and recycling of pollutants. However marshes are poor at dispersing pollutants and thus are vulnerable to becoming contaminated by large discharges of pollutants or by pollutants that cannot be broken down.

Pollutants have varied effects on the Bay's plant and animal communities. Toxic effects that quickly result in mortalities are said to be "acute." At lower levels, the same pollutants may have "chronic" effects that are more subtle and long-term, such as hampering reproduction or lowering the ability of a species to compete with others.

Certain heavy metals and petrochemicals can accumulate in Bay organisms to levels many times higher than their surrounding environment in a

process known as "bio-concentration." Clams, for example, which filter their food from large volumes of water, also concentrate these materials from the filtered water. Similarly, pollutants may become magnified in the "food-chain" of the Bay ecological system. Thus, pollutants that concentrate to low levels in Bay algae, may become more concentrated in the tissues of animals that graze on the algae (causing possible chronic effects), and become further concentrated in fish that feed on the grazers (resulting in possible acute effects). Pollutants that magnify in food chains, such as the banned pesticide DDT, can reach their highest concentrations in the creatures near the top of the food chain; in the Bay these include popular sport fishes such as sturgeon and striped bass. Humans who consume these fish are effectively putting themselves at the top of the Bay food-chain, and thus may be exposed to pollutants concentrated in the fish. For this reason, health advisories have been issued that warn against consuming large amounts of striped bass from the Bay and against any consumption of Bay striped bass by pregnant women.[11/]

Other substances become pollutants, not by direct toxicity, but by upsetting balances of the Bay ecological system. Examples, discussed later, include "bio-stimulants" that induce excessive plant growth.

4. Effects of Fill and Water Diversion. Significant filling of Bay waters would reduce the tidal prism and therefore might decrease the ability of the Bay to disperse, flush, and biologically process wastes. Filling of wetlands removes productive components of the Bay ecological system, that not only are effective at degrading wastes themselves, but which also are prime nursery habitats for many recreationally and commercially important varieties of fish and shellfish. Diversion of inflowing freshwater weakens the

estuarine current, which could decrease dispersion and flushing of polluted waters. Additionally, fresh water diversions affect Bay salinity gradients. Large scale reductions in fresh water inflow, such as occurred during the 1977-78 drought, could shift the distribution and abundance of Bay organisms, may adversely impact migratory and resident fishes such as the striped bass,[12/] and might place the null zone in a constricted, upstream area where its trapping mechanism could not be efficiently used by Bay organisms.

5. Information Needs. A major impediment to pollution control efforts is the lack of detailed knowledge about the Bay system. While excellent research has and is being performed, basic scientific information about the Bay is often not available because the necessary research has yet to be done. In the words of scientist Robert Brown of the U. S. Geological Survey: "We have a broad understanding of how the estuary and its biota work; we know generally what is good for the Bay and what is bad; but we need better quantitative data, both to aid in regulatory decisons and to rank the many different issues in terms of their importance and costs." And Don Anderson, chairman of the Regional Board, has stated that "a lack of understanding of the complex relationships between pollutant discharges, Delta outflow, and the health of [the] biological community of San Francisco Bay... rather than shortcomings in the law or its implementation, is now the major impediment to the RWQCB in carrying out its mandate."[13/]

Many scientific and governmental organizations are currently studying the Bay, for example the Interagency Ecological Study Program that includes the state Department of Water Resources, Department of Fish and Game, and the State Board, as well as the federal Fish and Wildlife Service, Bureau of Reclamation, and Geological Survey. Other research groups include the Tiburon Center for Marine Studies and the Ocean Assessment Division of the

National Ocean and Atmospheric Administration, tc name just a few. The Aquatic Habitat Institute is a non-profit organization that was established precisely to provide technical information about the Bay. Additionally, the federal Environmental Protection Agency has included the Bay in its estuary research program. A better understanding of the Bay system is emerging from the efforts of these groups, as well as practicable strategies to improve and protect the quality of the Bay's waters.

Pollutants

Numerous pollutants are discharged into Bay waters, from bird droppings to high-technology toxicants. Early pollution control efforts were primarily aimed at pollutants associated with municipal sewage: organic wastes, pathogens, and biostimulants. These are usually referred to as "conventional" pollutants. Now such toxic substances as heavy metals, oil and grease, and toxic organic chemicals must also be controlled. This section discusses the pollutants of most concern to the Bay, starting with conventional pollutants and then considering toxic substances.

Current and comprehensive information about the actual amounts of pollutants that enter the Bay is not available in a collected form. The most recent comprehensive data was published by the Association of Bay Area Governments (ABAG) in its 1978 estimate of pollutant loadings from fresh water inputs to the Bay, as shown on Table 1 (page 17) and Figure 3 (page 18). These estimates are in the form of total loadings rather than pollutant concentrations. Therefore, while the Delta is shown as the largest source of heavy metals, their concentrations in Delta inflow were probably very low.

Table 1
ESTIMATED FRESHWATER INFLOW AND POLLUTANT INPUTS
TO SAN FRANCISCO BAY, 1978

Source / Parameter	Municipal	Industrial	Total Point Source	Street Surface	Open Area	Other	Total Surface Runoff	Delta	Aerial Fallout	Total Bay Input
Flow	726 (192)	70 (19)	796 (210)	163 (43)	1109 (293)	167 (44)	1439 (380)	18777 (4960)	-757 (-200)	20255 (5350)
BOD	52 (115)	3.0 (7)	55 (122)	3.2 (7)	3.2 (7)	3.9 (8.5)	10 (23)	24 (52)	2.3 (5)	91 (202)
Total Suspended Solids	36 (80)	8.7 (19)	45 (100)	27 (59)	417 (921)	27 (60)	471 (1040)	1972 (4350)	79 (175)	2568 (5665)
Total Nitrogen	22 (49)	0.6 (1.4)	23 (50)	0.5 (1)	0.9 (2)	0.9 (2)	2.3 (5)	13 (28)	0.9 (2)	39 (85)
Total Phosphorus	11 (23)	0.04 (0.1)	11 (23)	0.05 (0.1)	0.1 (0.2)	0.1 (0.2)	0.2 (0.5)	2.3 (5)	0 (0)	13 (29)
Heavy Metals	0.4 (0.8)	0 (0)	0.4 (0.8)	0.6 (1.3)	0.7 (1.5)	0.5 (1)	1.7 (3.8)	2.9 (6.5)	0.2 (0.5)	5.3 (12)

Flow in millions of cubic meters per year (billions of gallons per year)
other constituents are in millions of kilograms per year (millions of pounds per year)

Total equivalent heavy metals expressed as chronic toxicity equivalent of chromium
Source: Association of Bay Area Governments

Further, these figures do not indicate the availability of the pollutants to Bay organisms. Needless to say, loadings may have changed significantly since the report was published.

1. Oxygen Demanding Wastes. Modern wastewater treatment plants are highly effective at removing oxygen-demanding wastes, which are those organic wastes that can be assimilated by bacteria or other aquatic organisms. Biological assimilation of these wastes consumes part of the water's dissolved oxygen, and the amount of oxygen required to degrade a given quantity of waste is called its biological oxygen demand (BOD).

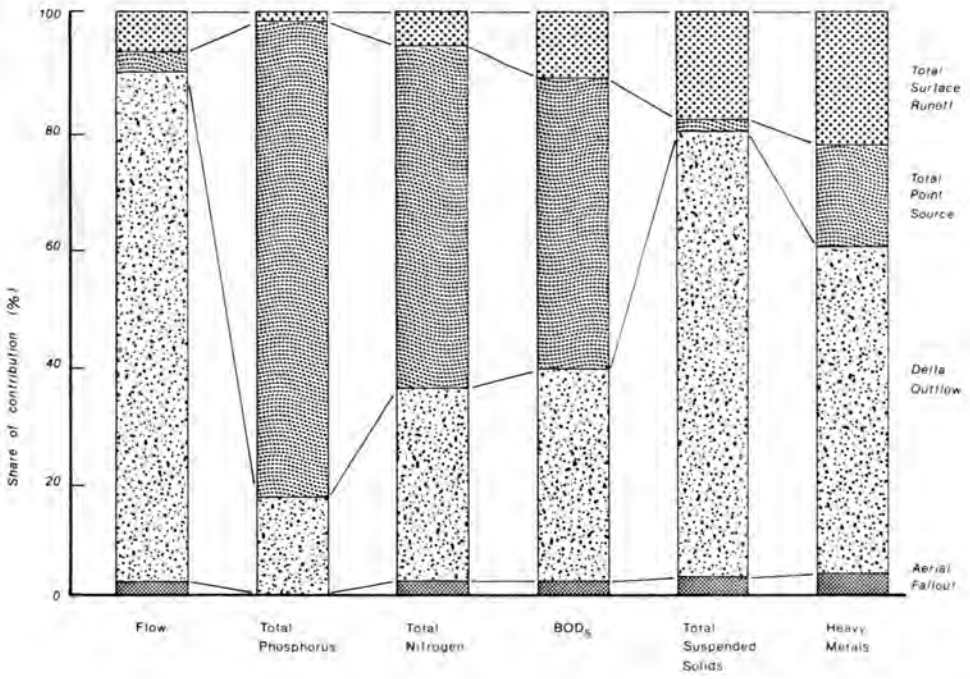


FIGURE 3

Estimated Freshwater Inflow and Pollutant Loading to San Francisco Bay, 1978

SOURCE: Association of Bay Area Governments

Dissolved oxygen is crucial to the survival of most Bay organisms and the main source of dissolved oxygen in Bay waters is from direct absorption from the atmosphere.[14/] Other sources include photosynthesis by Bay plant life, and oxygen contained in inflowing waters.

When the BOD of wastes released into a given area reduces the dissolved oxygen below that level needed to support aquatic organisms, then fish kills and collapse of the local ecological system may result. Conditions of low dissolved oxygen were common in South Bay waters during the 1960's and were also suspected of causing the unpleasant odors that used to emanate from the Eastbay mudlflats.

Improved treatment of wastewater discharges (described in Chapter II) have reduced BOD loadings substantially (see Figure 4. page 21) and now ensures that dissolved oxygen levels in most parts of the Bay remain at levels adequate to support Bay organisms. Certain areas, however, such as the extreme South Bay and Suisun Marsh still experience impaired oxygen levels on occasion[15/], and transitory high BOD loadings to the Bay also occur during wet weather overflows and treatment plant upsets.

Other sources of BOD, in addition to municipal wastewaters, include industrial discharges, Delta inflow, and non-point sources such as urban runoff, animal confinement area runoff, and vessel wastes (see Table 1 on page 17 and Figure 3 on page 18 for a partial listing).

2. Pathogens. Pathogens are microorganisms and viruses that cause illness. In the past, municipal wastewaters contributed most pathogenic contaminants to the Bay. Now, as this source is controlled, other sources such as surface runoff and vessel wastes are becoming more significant.[16/]

The impact of pathogens varies with the intended uses of the contaminated waters; small concentrations of pathogens will render drinking water unfit for human use, while higher levels will contaminate resident shellfish and make them unfit for human consumption, and even higher pathogen levels will render water contact recreation hazardous to human health. Measurements of the abundance of "coliform bacteria," which originate from the digestive tracts of warm-blooded animals, are used to determine the extent of pathogenic contamination.

Improved treatment of municipal wastes has so effectively decreased pathogen loadings to the Bay that some areas may now be safe for recreational harvesting of shellfish.[17/] All Bay shellfish, however, should be

considered unsafe for consumption during wet weather when pathogens from stormwater runoff and sewage overflows can make even water-contact recreation unsafe.

3. Biostimulants. Certain chemicals, notably nitrogen and phosphorus, promote aquatic plant growth and so are called "biostimulants." Biostimulants become pollutants when they produce nuisance blooms of aquatic plants, such as algae. The resulting increase in respiration and decomposition of aquatic plants during these blooms may consume the oxygen in the affected waters, stressing or killing fish and other aquatic organisms.

Nuisance blooms of algae occasionally occur in the Bay, while these sporadic occurances are largely unexplained, the high levels of nitrogen and phosphorus present throughout its waters may be implicated.[18/] ABAG's estimates show municipal wastewaters as the dominant freshwater source of biostimulants (see Figure 3 and Table 1). Nitrogen emitted in the form of un-ionized ammonia is particularly noxious since it is poisonous and its chemical breakdown also consumes dissolved oxygen. The minimum sewage treatment level now required for all municipal dischargers (see municipal discharger and regulation sections) removes only a small percentage of biostimulants, but more advanced treatments can remove biostimulants or eliminate toxic ammonia (standards for ammonia are quite strict). These advanced treatments entail significant additional construction and maintenance costs and so are used only where required to maintain receiving water quality.

Although biostimulants are present in many parts of the Bay at levels that could cause nuisance blooms, other factors appear to be controlling the growth of aquatic plants.[19/] In the South Bay, grazing by benthic filterfeeders may be controlling plant levels, while in the northern

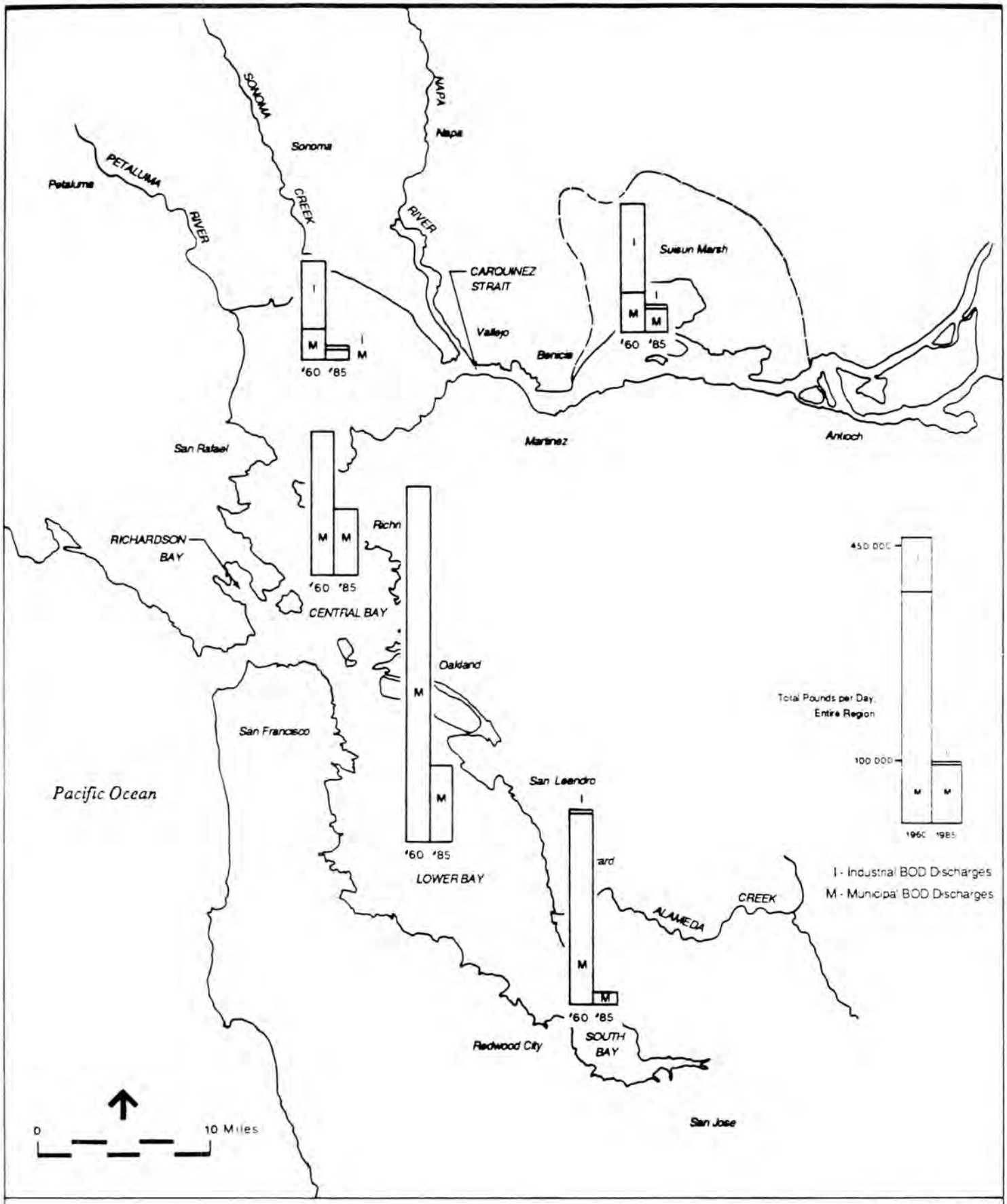


FIGURE 4

Biochemical Oxygen Demand (BOD) Discharges to San Francisco Bay, 1960 versus 1985

SOURCE: San Francisco Bay Regional Water Quality Control Board

reach, water turbidity, salinity, and temperature levels appear to limit growth at this time. If these controls were to be removed, however, serious plant blooms might result.

4. Trace Elements. Trace elements are substances that are normally present in the environment at very low levels but that are often toxic when present at elevated levels. The so-called "heavy metals" such as lead, chromium, and mercury are the best known trace elements, but other elements such as arsenic, zinc, and selenium also can have toxic effects.

High levels of heavy metals or trace elements may cause acute toxic effects in human and aquatic organisms, while lower levels may cause more subtle chronic effects, such as reproductive problems. Levels of heavy metals and trace elements in San Francisco Bay are greater than those in neighboring coastal areas. While the Bay-wide levels are not thought to be of serious concern, concentrations within the Bay vary widely and localized "hotspots" rival those found anywhere in the world.[20/] These hotspots have been associated with outfalls discharging heavy metals,[21/] and also with improper disposal of toxic wastes such as the Point Isabel battery dump, which has since been removed.

According to ABAG's estimates (see Figure 3 and Table 1), Delta-inflow is the major source of heavy metals to the Bay; however, concentrations of heavy metals in Delta outflow are low. Other sources include surface runoff, point sources, and aerial fallout. Unquantified sources include toxic spills and waste sites. Some of these elements come from natural erosion of rock and soils, but most are thought to result from human actions.[22/] For example, polluted runoff from mining sites may contribute a large percentage of the metals found in Delta inflow and lead in surface runoff may result from the continued use of leaded gasoline.

Heavy metal concentrations in the Bay vary with the location of their sources and local dispersion characteristics.[23] The South Bay appears particularly subject to heavy metal contamination due to its poor flushing action and the abundance and volume of point source and runoff inputs. For example, in 1980, it was estimated that 869 pounds of heavy metals entered the South Bay each day from wastewater treatment plants alone,[24] while only 200 pounds per day are presently discharged by all Bay industrial discharges.[25]

Shellfish serve as monitors of heavy metal water pollution, because they filter large quantities of water and concentrate pollutants in their tissues. The State Mussel Watch (SMW), conducted by the State Board and the Department of Fish and Game, has been analyzing pollutant levels in mussels taken from monitoring stations along the coast and bays of California since 1977.[26] The 1983-84 SMW report stated that San Francisco Bay is "on the whole, a relatively clean body of water...," with the exception of locally elevated pollutant levels. However, it indicated that South Bay cadmium levels were higher than 90 percent of California samples ("highly elevated"), and above the median international standards for cadmium in shellfish. The South Bay shellfish also had highly elevated levels of chromium, zinc, mercury, and elevated (over 75% of California samples) of manganese. Other researchers[27] have reported South Bay shellfish levels of cadmium and silver equal to the highest measured in other U.S. shellfish, and copper and silver levels higher than 37 polluted European estuaries. Additionally, shellfish in Redwood Creek, Redwood City were found to be highly polluted with heavy metals, especially silver.[28]

The SMW station near to Treasure Island revealed highly elevated levels of aluminum, chromium, and mercury as well as elevated levels of zinc.

The San Pablo Bay station had highly elevated levels of mercury and elevated levels of chromium and cadmium. Later SMW data (1984-1985) indicates high levels of lead in the Alameda station, and a long standing hotspot of lead at Point Isabel from dumped batteries (this site has since been cleaned up under Regional Board supervision and a Commission permit).

Because a majority of heavy metals may come into the Bay from Delta inflow, it is important to note that the State Board's 1983 State Toxic Substance Monitoring Program (TSM) found high levels of mercury, cadmium, and chromium, and also elevated levels of copper and zinc in fish from the Sacramento River.[29/]

Introduction of improved treatment for municipal wastewaters, in concert with source control programs (these improvements are discussed later in this report), has significantly decreased heavy metal loadings from municipal sources.[30/] Runoff pollution control measures, as discussed on page 43, could significantly reduce heavy metal loadings from non-point sources.

Toxic selenium compounds have recently become of concern due to their poisoning of migratory birds in Kesterson Reservoir National Wildlife Refuge, in the western San Joaquin Valley. The suspected source of the selenium is irrigation wastewater from certain selenium rich soils in the Central Valley area. The proposed San Luis agricultural drain, if built, would empty this selenium-tainted irrigation water directly into the lower Delta near Antioch. The selenium rich soils are also within the San Joaquin River drainage, and large amounts of irrigation wastewater are discharged to the San Joaquin. The Central Valley Regional Board is establishing a program to quantify these selenium discharges.[31/] Whether selenium from this source

selenium from this source has any adverse effects on the Bay or even if it reaches the Bay is unconfirmed.

Recent studies[32/] disclose that diving ducks in the South Bay and Suisun Marsh contain selenium at levels found to have toxic effects in dabbling ducks at Kesterson. Whether these levels are toxic to diving ducks is still undetermined, but human health advisories have been issued to restrict consumption of diving ducks taken from the Suisun Marsh.

Selenium has only recently come under suspicion of being a Bay pollutant; therefore the amounts and sources of selenium to the Bay have yet to be quantified or even identified, but could include petrochemical and computer chip-making industries, or agriculture wastewater in Delta outflow.

5. Oil and Grease. San Francisco Bay receives a chronic low-level input of oil and grease pollution. Sources include industrial and municipal wastewater discharges, urban runoff, and oil spills. The many kinds of oil and grease that reach the Bay as pollutants can be divided into two main categories: petroleum products such as crankcase oil, and non-petroleum oil and grease from plants and animals. The petroleums vary widely in their toxicity and are usually more toxic than non-petroleum oil and grease.

The impacts on Bay organisms of oil and grease discharges depend on the toxicity of their components as well as the total amount and concentration of the discharge. For instance, it may be that direct spills of petroleum oils to the Bay have greater effects on the Bay than the diffuse levels of varied oils contained in municipal wastewaters because the spills are more concentrated and may be more toxic.

The toxicity to aquatic life of low concentrations of petroleum hydrocarbons is related to their solubility in water, and petroleum products that are "aromatic" tend to be more toxic (aromatic chemicals contain rings in

their molecular structure that can make them toxic and carcinogenic).[33/] These aromatic structures are found in many petroleum products such as the solvent benzene and in crankcase oil. At low concentrations, refined oils are generally considered more toxic than crude oils because they often have a higher fraction of aromatics and are usually more water soluble.[34/]

The effect on estuarine life of chronic low-level exposure to petroleum hydrocarbons has not been well characterized and is largely unknown.[35/] Concentrations of petroleum hydrocarbons in Bay mussels average 20 times higher than mussels on the nearby northern California coast.[36/] Cancer-like tumors were found in Bay mussels by the 1976-77 National Mussel Watch program with the highest incidence in the North Reach of San Francisco Bay, where petroleum refineries are concentrated. Because aromatic petroleums are known carcinogens, further investigation has been suggested.[37/] However, there is presently no data supporting any correlations. Reduced reproductive success in Bay flatfish (starry flounders) has been correlated with tissue levels of organic chemicals, including aromatic hydocarbons.[38/] Further, poor health and population declines in Bay populations of striped bass have been correlated with tissue levels of aromatic hydrocarbons.[39/] These correlations, however, do not prove causality.

Removal of diffuse hydrocarbon loads from wastewaters is presently difficult and expensive. ABAG is studying the use of marshes to remove diffuse pollutant loads, including hydrocarbons.[40/] Preventing oil and grease from entering wastewaters may prove the most efficient and cost effective approach, and such efforts could include intensified streetsweeping and oil recycling programs as well as stricter pre-treatment standards for industries discharging into municipal systems (discussed further in Municipal Sources and Regulation sections).

6. Organic Chemicals, Solvents, and Pesticides. This category includes all chemicals refined or manufactured from petroleum, such as the PCBs. New technologies have increased human and environmental exposure to synthetic organic chemicals, making control of toxic chemicals a high priority. Although many synthetic chemicals pose no special problems, others are or may become serious pollutants. Part of the cost to society of the beneficial use of these chemicals is disposing of them properly--or enduring the pollution that they create.

Most synthetic organic chemicals are derived from petroleum, and come in a near endless variety. Many of them, including DDT, are significant pollutants and as a group they dominate the EPA's list of 129 priority pollutants.

The behavior, toxicity, and fate in aquatic environments of most synthetic organic chemicals is poorly understood. Synthetic organic pollutants in the Bay are present in low concentrations, except for such hot spots as Lauritzin Canal in Richmond where bottom sediments contain very high levels of DDT[41/]. Even at low concentrations, however, these chemicals may have chronic or even acute effects. The recently banned pesticide toxaphene, for example, is chronically toxic to aquatic life in concentrations of only a few parts per trillion.[42/] Monitoring and detecting low concentrations of these pollutants in wastewaters, receiving waters, sediments, and organisms is a formidable task. Identifying the effects of these pollutants on Bay organisms is further complicated by the complexity of the Bay's physical and biological systems. For instance, it is often impossible to discern or prove whether a species population is changing due to the impacts of pollutants, or is simply responding to complex variations in salinity, temperature, and life cycles.

Some of the most commonly used organic chemicals are simple solvents like benzene and toluene. These chemicals are used as cleaning solvents, carrier solvents, pesticides, and make up the most soluble fraction of petroleum oils and fuels.[43/])

As stated earlier, the presence of "aromatic" ring structures in a chemical is associated with increased toxicity and carcinogenicity. Many common solvents such as benzene and xylene have a single aromatic structure (mono-cyclic aromatics or MAH) and are known carcinogens. Aquatic organisms such as shellfish can concentrate these solvents in their tissues.[44/] However, these chemicals will usually be purged when the organism returns to unpolluted water. Chemicals with several aromatic groups (poly-aromatic hydrocarbons or PAH), are both more toxic than the MAH aromatics and are purged more slowly.[45/]

The presence of chlorine in organic chemicals is also associated with increased toxicities. Several commonly used industrial solvents such as TCE and carbon tetra-chloride are chlorinated. These solvents are among the chemicals which have contaminated groundwaters in the Silicon Valley area of the South Bay. Several toxic chlorinated organic chemicals also form as an unintended result of the disinfection of wastewaters.[46/]

Higher-molecular weight chlorinated organic chemicals are undoubtedly the most infamous of pollutants. They are broadly toxic, extremely persistant in the environment, and concentrate in animal tissues and food chains; they include poly-chlorinated biphenyls (PCBs), DDT, and many other pesticides.

The State Mussel Watch Program (1983-1984) found elevated levels of these organo-chlorines in Bay mussels, including PCB, DDT, DDE, lindane, dieldrin, and endosulfan.[47/] Dieldrin levels in Bay mussels were higher

than 90 percent of California mussels tested. Although DDT and DDE have been banned since 1972, they have been found in the Richmond inner harbor at levels that are among the highest ever recorded in California.

7. Other Pollutants. The pollutants discussed are intended to provide an overview of the major categories of concern in Bay water pollution control. However, they are not a complete listing. Other pollutants of concern include: cyanide from industry, copper-based wood preservatives, and "organotin" anti-fouling ship paints. Organotin is a highly toxic substance that is finding increasing usage on ship and boat hulls to reduce the growth of marine organisms. These substances are of particular concern in enclosed marinas lacking high rates of dispersion. The State Board is presently evaluating appropiate water quality standards for organotins that will protect the Bay and public health from a chemical used precisely because of its high toxicity.

Pollution Effects on Bay Organisms

The presence of small amounts of exotic chemicals is not necessarily a cause for alarm, unless they have adverse affects on Bay organisms or other beneficial uses of the Bay. Much of the present uncertainty and concern over Bay pollution, therefore, stems from the lack of firm knowledge about the actual effects of these pollutants and the time required for their effects to become apparant.

As noted earlier, pollution effects on Bay organisms can either be acute (short-term) or chronic (long-term). Acute effects in the Bay today are probably mostly associated with toxic spills.

Chronic toxic effects are often subtle and difficult to tie to any specific pollutant. For instance, even while causing no apparent change in a species population, chronic stresses can increase that species' vulnerability to other environmental stresses, just as few people die of starvation, but succumb instead to other diseases brought on by malnutrition.

As part of the State Mussel Watch Program Bay mussels were measured for physiological stress. The observed stress levels were positively correlated with mussel tissue burdens of pollutants, including amounts of chromium, mercury, copper, dieldrin, and chlordane[48/]. Silver and zinc levels were also correlated with physiological stress, but to a lesser degree.

Striped bass are long-lived fish which are near the top level in the Bay food chain. Due, in part, to the magnification of certain pollutants in food chains, pollution effects are often first identified in such species. The relative health of striped bass is thus thought to be a bellwether of the health of the Bay. Striped bass populations in the Bay have suffered precipitous declines (although 1986 striped bass levels have shown an increase), and are in poorer health than striped bass in either Oregon's Coos River or New York's Hudson River.[49/]

Many causes have been advanced for the decline of striped bass populations, including the effects of overfishing, water diversions, and fish entrainment. Recent studies suggest that the decline of striped bass in the Bay may also be due, in part, to pollution effects. Pollutant burdens in striped bass have been correlated with declines in their reproductive capacity and health.[50/] The correlated pollutants are the mono-aromatic hydrocarbons mentioned earlier and the trace element zinc.

The striped bass is not the only fish whose population has declined. Due to these declines, San Francisco Bay commercial fisheries have shifted from harvesting commercially valuable species at the top of the food-chain, such as bass, salmon, and sturgeon, to smaller more rapidly-reproducing species such as herring.

Pollution may be contributing to the declines of these fish species. Pollutants and their stresses shift in time and location within the Bay. Long-lived, slower reproducing fishes, such as striped bass, may not adapt to frequently shifting environmental stresses as successfully as rapidly reproducing species such as herring. Therefore, by making the Bay a more patchy and unpredictable environment, it is possible that pollutant stresses may tend to favour the success of more rapidly adapting species.[51/]

Given the short-term toxic effects of pollution, the tendency of certain pollutants to concentrate in organisms and magnify in food-chains, and the chronic stresses pollution exerts on Bay organisms, it is possible that pollution, in concert with other factors such as over-fishing and water diversions, have played a role in shifting the Bay's ecological system towards more adaptable, but commercially less valuable species.

CHAPTER II. POLLUTION SOURCES

Wastes reach the Bay from many sources. Some are dramatic, like the collision of two oil tankers in 1971, while others, such as the illegal dumping of toxic wastes into storm drains emptying to the Bay, are covert and difficult to detect. Many, however, are routine wastewater discharges regulated by Regional Board permits. This chapter discusses the major sources of waste discharges to San Francisco Bay and approaches to controlling them.

Municipal sewage discharges and industrial wastewaters are regulated as "point sources" by the Regional Board. As shown on Figure 3, page 18, point sources are estimated to be the major contributers of biological oxygen demand (BOD) and biostimulants. Non-point sources include polluted urban runoff from streets and parking lots, erosion from construction sites and from agriculture, pollutants in fresh water inflow, pollutants from toxic waste sites and dumps of all kinds, direct spills of pollutants to the Bay, dredging, and vessel waste discharges.

Point Sources

1. Municipal Sewage Discharges. Forty-five municipal sewage treatment plants discharge treated wastewater into San Francisco Bay, the locations of these plants and their discharge points to the Bay are shown in Figure 5, page 34). The average dry weather flow in 1986 from these plants is estimated to be 712 million gallons a day (MGD) (see Table 2, page 35).[1/]

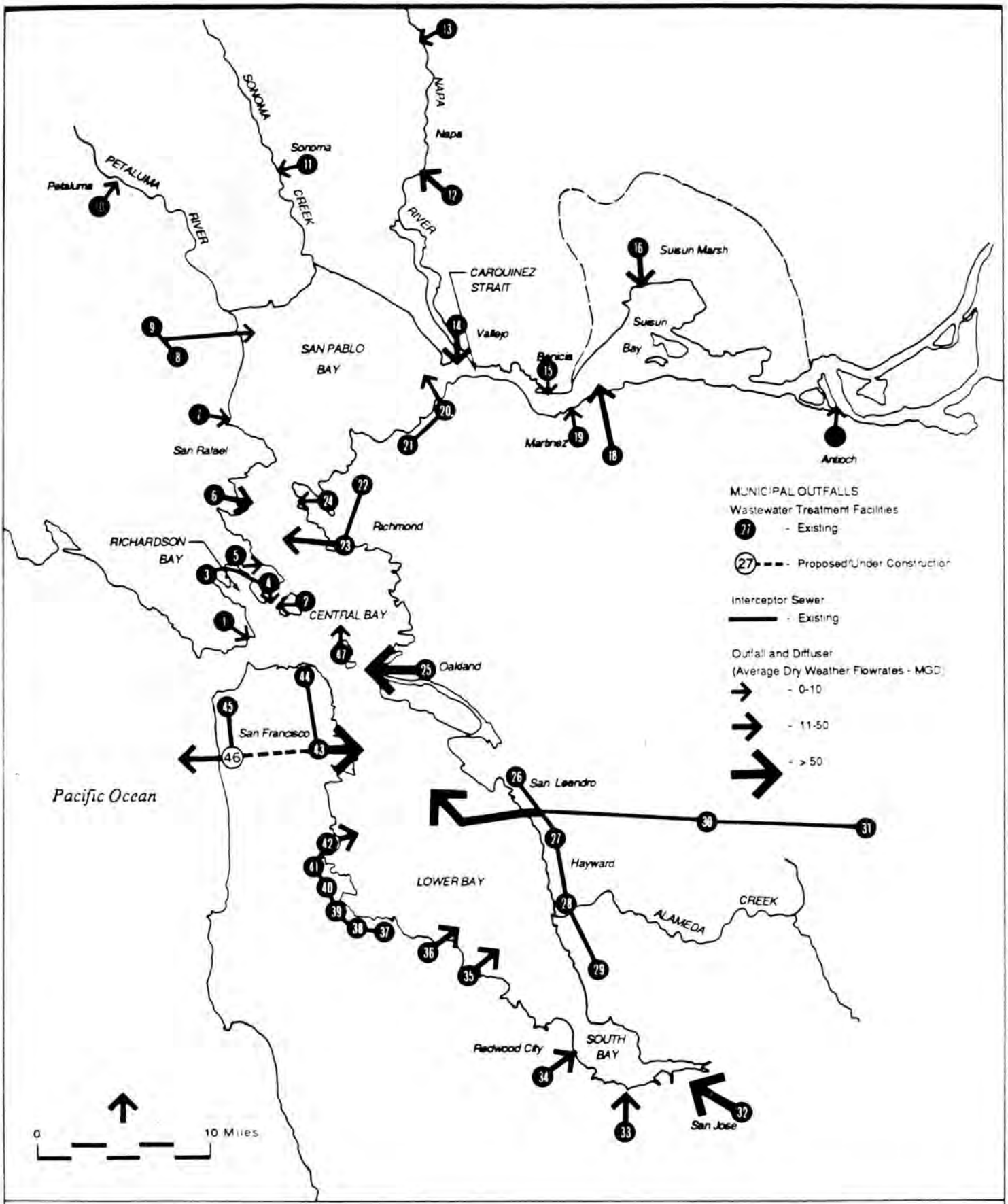


FIGURE 5

Location and Magnitude of
Municipal Discharges to San Francisco Bay

SOURCE: San Francisco Bay Regional
Water Quality Control Board, 1986

TABLE 2
AVERAGE DRY WEATHER DISCHARGES OF MUNICIPAL TREATMENT PLANTS
(millions of gallons per day MGD)

1 - Sausalito-Marin Sanitation District (SD)	1.8
2 - State Parks and Recreation Department-Angel Island	.004
Common Outfall	
3 - Mill Valley Water Treatment Plant (WTP)	3.5
4 - Marin County SD #5-Tiburon	1.4
5 - Marin Co. SD #5-Paradise Cove	0.01
6 - Central Marin San. Agency	11.6
7 - Las Gallinas WTP	3.7
Common Outfall	
8 - Ignacio SD	1.3
9 - Novato SD	4.1
10 - Petaluma WTP	7.6
11 - Sonoma Valley WTP	3.7
12 - Napa SD	12.8
13 - Yountville WTP	0.5
14 - Vallejo SD	12.6
15 - Benicia WTP	2.9
16 - Suisun-Fairfield SD	12.8
17 - Delta Diable SD	9.5
18 - Central Contra Costa SD	41.5
19 - Mountain View SD	1.7
Common Outfall	
20 - Rodeo WTP	1.0
21 - Pinole WTP	2.3
Common Outfall	
22 - West County Agency Contra Costa County	6.8
23 - Richmond WTP	6.7
24 - Point Molate WTP (Navy)	0.4
25 - East Bay Municipal Utilities District	92.6
Common Outfall	
26 - San Leandro WTP	5.0
27 - Oro Loma SD	15.9
28 - Hayward WTP	12
29 - Union SD	20.6
30 - Dublin-San Ramon Service District	7.8
31 - Livermore WTP	63.5
32 - San Jose/Santa Clara WTP	121.0
33 - Sunnyvale WTP	18.7
34 - Palo Alto WTP	27.6
35 - South Bayside System Authority	24.5
36 - San Mateo WTP	13.6
Common Outfall	
37 - Burlingame WTP	4.24
38 - Millbrae WTP	2.0
39 - San Francisco Int'l Airport-Ind. WTP	1.5
40 - San Francisco Int'l Airport-WQCP	
41 - South San Francisco and San Bruno-WTP	8.9
42 - CALGON (Industrial)	2.9
Common Outfall	
43 - San Francisco Southeast Plant	83.2
44 - San Francisco North Point Plant (only operational during wet weather)	3.0
45 - San Francisco Richmond Sunset Point	22.0
46 - San Francisco Southwest Plant (Proposed)	10.7
47 - Navy Support Agency Treasure Island	0.7

Much of the historic water pollution of the Bay was caused by organic pollutants discharged in municipal sewage, and the marked improvement in Bay water quality since the 1950's is due in large part to the upgrading of municipal treatment facilities as required by the Regional Board, pursuant to state and federal law. To achieve the objectives of the federal Clean Water Act and the state Porter-Cologne Act (discussed in the following chapter), the State and Regional Boards have imposed a series of measures to abate pollution from municipal sewage, the most notable of which are improved sewage treatment, better discharge locations (deep water outfall locations that rapidly mix and diffuse the treated effluent with Bay waters), measures to control wet weather overflows (discussed on page 38), and pre-treatment programs to limit discharge of certain pollutants to the treatment system. These measures have resulted in estimated reductions of BOD by 75 percent, suspended solids by 70 percent, and oil and grease by 70 percent, as well as substantial reduction in heavy metals and other toxics.[2/]

Sewage treatment plants usually operate at one of three main levels of treatment: primary, secondary, or tertiary. The primary sewage treatment level consists only of wastewater disinfection and removal of settleable solids. Secondary treatment (the minimum treatment level for Bay sewage treatment plants) adds accelerated biological digestion and filtering to remove over 90 percent of the organic matter from wastewater, thus resulting in over 90 percent removal of biological oxygen demand.[3/] Tertiary treatment is the most complete but expensive treatment level, and can (at least in theory) actually restore wastewater to drinking water standards. Although tertiary treatment is the most desirable level of treatment, secondary treatment eliminates most pollutants at far less expense than tertiary treatment.

State and federal law requires all municipal sewage plants to operate at the secondary level of treatment or better and all Bay Area plants now meet this requirement during dry weather, almost a third of the municipal wastewater discharges receive tertiary treatment.[4/]

a. Discharge locations. The adverse effects of wastewater pollutants are intensified when wastewater is discharged in areas of poor dispersion and flushing. Consequently, the Regional Board has required the relocation of wastewater outfalls from the shallow margins of the Bay, such as Richardson Bay, and their consolidation for discharge to deeper waters that have superior water dispersion and flushing. Diluting wastes may not be a solution to pollution problems, but is, along with treatment and source controls, an important technique to reduce pollution impacts.

Many smaller municipalities have joined together to form regional discharge authorities, which collect and treat sewage from member communities for combined discharge to deepwater. The South Bay dischargers (SBD), including the City of San Jose, discharge to shallow dead-end sloughs in the extreme South Bay. To attain water quality standards for the receiving waters, these dischargers must operate at tertiary treatment levels. In addition, the SBD are engaged in a five year study, as required by the Regional Board, to determine if South Bay water quality would be improved by moving their discharge to deeper water north of the Dumbarton Bridge.

The City of San Francisco has embarked on a massive clean water program designed to treat and discharge all its wastewater (with the exception of wet weather discharges) to the Pacific Ocean. This program has resulted in substantial improvements to San Francisco's sewage treatment

system and a deep water outfall to the Pacific Ocean. Unfortunately, reduced federal funding may delay or preclude construction of the crosstown transport system needed to pipe wastewater to the Ocean. Meanwhile, San Francisco's Bay discharge has remained in shallow water at Islais Creek on the south-central waterfront. To remedy this problem, the Regional Board is requiring San Francisco to lengthen the Islais Creek outfall into deeper water.

b. Treatment Bypasses. Many municipal treatment systems periodically discharge inadequately treated sewage during wet weather overflows or treatment plant failures. Bypasses occur chiefly when heavy storm waters swell flows in sanitary sewer systems beyond the capacity of treatment plants. Such discharges can result in serious Bay pollution and are of particular concern near shellfish beds or areas supporting water contact recreation, especially where water dispersion is poor.

The wet weather system improvements required by the Regional Board are designed to reduce treatment bypasses to the greatest extent that is economically feasible and to a level at which the Bay will be able to assimilate the resulting pollutant discharge. (Fortunately, wet weather overflows occur when dispersion and flushing in the Bay are at a maximum, because of high freshwater inflow and Bay turbulence caused by winter storms.)

San Francisco has the only Bay Area system that combines its storm and sanitary sewers into a single system. The combined flow of sewage and storm water runoff during heavy rains often overwhelms the system's treatment capacity, forcing the release of inadequately treated sewage into the Bay. However, when San Francisco's improvements are completed, wet weather overflows should be reduced to a frequency of ten days per year at the primary treatment level,[5/] whereas in the past it has experienced as many as eighty overflow days per year.

Similar wet weather overflows plague other municipal systems, due to infiltration and inflow of storm waters into old or damaged sewer lines. To remedy this problem, the East Bay Municipal Utility District and its member communities are currently embarked on major programs to minimize stormwater infiltration and the incidence of overflows.

Treatment bypasses also occur on occasion due to equipment failures. For example, the City of San Jose experienced major overflows to the south end of the Bay in 1979-80, but has since improved the reliability of its equipment.

c. Pre-treatment. Most commercial and industrial producers of wastewater discharge into municipal wastewater treatment systems. These discharges can contain levels of pollutants that might pass through or damage municipal treatment plants. To illustrate, large releases of acids from an industrial discharger might upset the plant's biological treatment process, or high volumes of food processing wastes might overwhelm the plant's treatment capacity, and finally, certain toxicants can pass through treatment plants unscathed. Therefore, to prevent these problems, "pre-treatment" standards regulate industrial discharges into the collection system.

2. Direct Industrial Discharges. Many industries, such as oil refineries, treat their own wastewater and discharge the treated effluent directly to the Bay. There are 154 direct industrial Bay dischargers, 16 of which are considered by the Regional Board to be major dischargers (see Table 3 page 40). The rest are mostly small dischargers of cooling waters and/or surface runoff from the industrial facility. The major dischargers released about 814 MGD of wastewater in 1981, 758 MGD of which was mainly "one pass cooling water" (water circulated once through the plant); however, even cooling waters can contain pollutants, such as toxic anticorrosion chemicals. The locations of these discharges are shown on Figure 6, page 41.

Table 3
AVERAGE DRY WEATHER DISCHARGES OF MAJOR INDUSTRIAL DISCHARGERS

	Facility Name	Industrial Category	Flow[a]	Treatment System
1	Allied Chemical Co. Bay Point Works	chemical manufacturing	1.7	pond
2	C and H Sugar Co.	sugar processing	23.8[b]	activated sludge
3	Chevron Chemical Co.	chemical manufacturing	0.26	pond
4	Chevron USA	petroleum refining	80.9[c]	pond
5	Dow Chemical Co.	chemical manufacturing	0.45	pond
6	Exxon	petroleum refining	2.3	activated sludge/pond
7	FMC - Newark	phosphate manufacturing	0.09	neutralization/pond
8	Merck and Co.	chemical manufacturing	2.9	physical/chemical
9	PG&E - Pittsburg Power Plant	steam electric power-plant	632[c]	filtration
10	San Francisco International Airport	various[d]	0.51	physical/chemical
11	Shell Oil Co.	petroleum refining	3.2	activated sludge/pond
12	Stauffer Chemical Co.-Martinez	chemical manufacturing	0.09	neutralization/pond
13	Stauffer Chemical Co.-Richmond	chemical manufacturing	0.15	activated carbon/ neutralization/pond
14	Tosco Corp.	petroleum refining	3.1	rotating biological contactor/filtration
15	Union Oil Co.	petroleum refining	45[c]	activated sludge
16	United States Steel Corp.	iron and steel manufacturing	17.1	physical/chemical

Footnotes:

a. Average daily wastewater discharge, 1986 (mgd).
b. Includes waste from Crockett-Valona Sanitary District.
c. Mainly once-through cooling water. Treatment applies only to non-cooling process wastes.
d. Treats waste for several industrial plants in the airport.

Source: San Francisco Bay Regional Water Quality Control Board

Most of the major dischargers are petroleum refineries and chemical manufacturers and 80 percent of the major direct industrial dischargers are located in Contra Costa County.

Waste streams from Bay industries can contain a wide range of pollutants, from bacteria, cyanide, and heavy metals, to new synthetic chemicals whose environmental effects are largely unknown. Consequently, treatment of industrial wastewaters varies from biologic treatment of cooling waters to advanced chemical treatment of highly toxic wastewaters. In addition to meeting water quality standards for receiving waters, state and

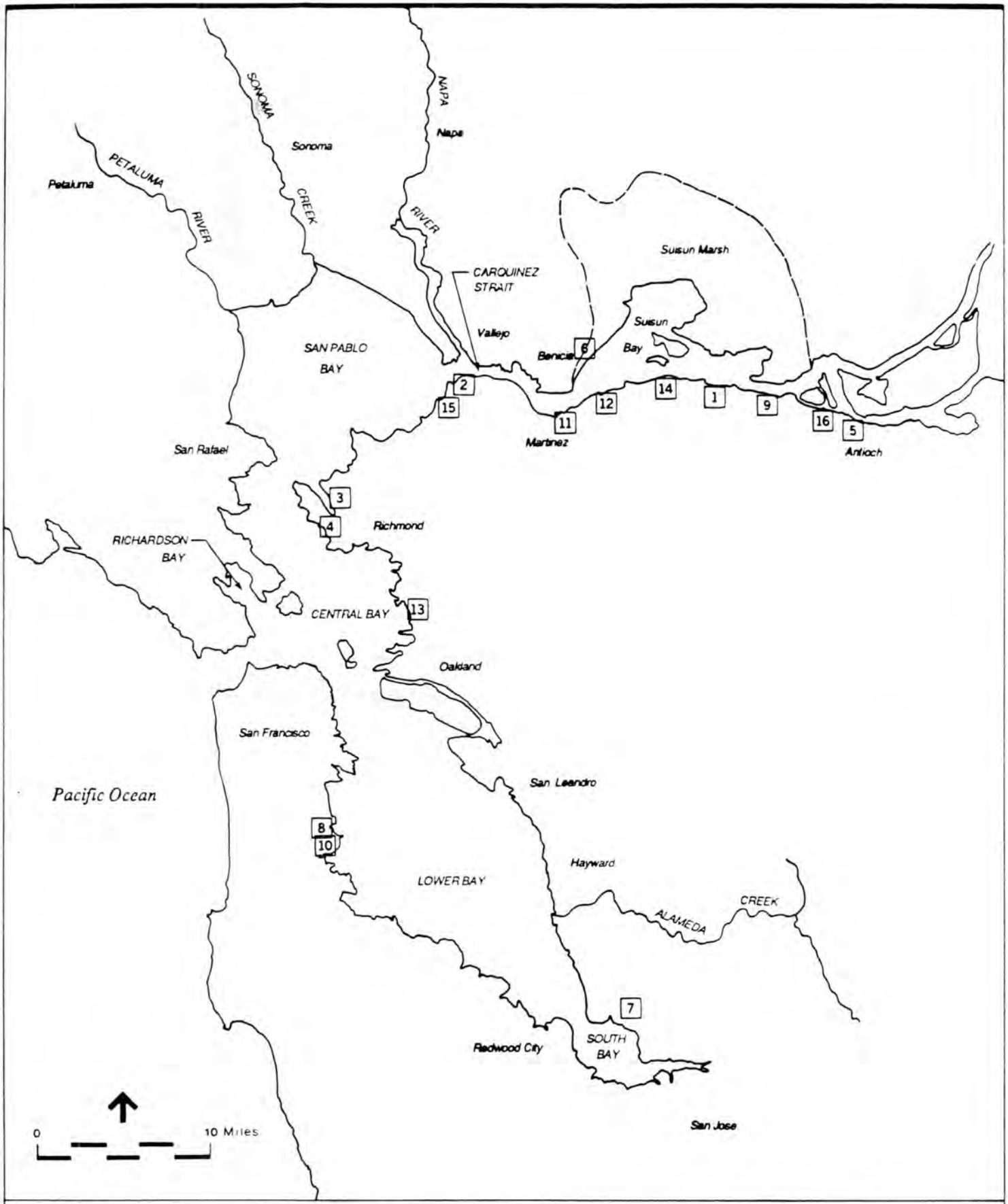


FIGURE 6

SOURCE: San Francisco Bay Regional Water Quality Control Board, 1986

Major Industrial Discharges to San Francisco Bay

federal law requires each industry to use the Best Available Technology (BAT) for treating its discharges (see chapter on regulation). The Regional Board's deep water outfall policy also applies to major industrial dischargers, and the Regional Board has required these dischargers, such as the Chevron petroleum refinery in Richmond, Contra Costa County, to construct deepwater outfalls for their wastewater discharge.

Mounting evidence and public concern regarding the toxic effects of industrial wastes is being translated into stronger regulation of industrial discharges. As a result, the Regional Board, which was the first in the nation to require bioassays to control discharge toxicity, is moving strongly to enforce its mandate. Since the 1960's, the estimated volume of industrial discharges has declined 75 percent, BOD by 95 percent, suspended solids by 98 percent, and there have been significant reductions in heavy metals and toxics.[6/] Increased regulation and treatment costs may induce industries to reduce pollutant production, through different production processes and such conservation measures as increased recycling of wastewater, multiple use of process streams, and separation of cooling water from industrial process waters.

Nonpoint Sources

Regulation of municipal and industrial point sources by the Regional Board has been highly successful in reducing Bay pollution due to organic wastes. The emphasis in pollution control is now shifting towards toxic chemicals and the control of pollution from nonpoint sources. Nonpoint sources include urban and agricultural runoff, erosion induced sedimentation, pollutants in Bay tributary inflows, leacheate from toxic waste sites, from air pollution, toxic spills, and dredging of polluted Bay sediments.

1. Urban Runoff. Surface runoff from urbanized areas is a major source of Bay pollution and is estimated to contribute more heavy metals than direct municipal and industrial dischargers (see Figure 3 page 18) as well as significant amounts of oil and grease. Runoff can contain toxic chemicals, including levels of aromatic hydrocarbons that are acutely toxic to certain aquatic organisms.[7/] Automotive oil and grease appear to be important sources, through leakage, crankcase and exhaust emissions, and dumping of waste oil.[8/] Similarly, much of the lead in urban runoff may come from leaded gasoline. Sediment from construction erosion, and bacteria loads (mainly from non-human sources) also significantly pollute runoff.

Although some surface runoff flows into sewers, most enters storm drains which discharge directly to the margins of the Bay. As discussed earlier, these areas often have the poorest water dispersion while containing some of the most productive and sensitive components of the Bay ecological system. The Bay's ability to assimilate and disperse wastes varies with location in the Bay, and consequently runoff pollutants may cause greater problems in areas with poor dispersion and flushing. Additionally, certain areas of the Bay support especially sensitive and/or imortant biological resources, such as shellfish beds or endangered species habitat. Therefore, while runoff pollution threatens the water quality of the entire Bay, certain areas may be especially at risk to pollution from runoff.

ABAG estimates that approximately 322,500 acres of land in the Bay Area will be converted to urban use by the year 2000.[9/] This represents a 73 percent increase in the urbanized area over that in 1975. Unless control measures are implemented, pollution from surface runoff will significantly increase as impermeable surface displaces open land.

Treating urban runoff is difficult and expensive because most of it discharges during the infrequent high-flows of winter storms. The massive, expensive facilities required to treat these storm flows would sit idle for most of the year. Treatment of low-volume flows during dry weather poses fewer problems and could be achieved by on-site treatment such as oil and grease separators or by diversion to municipal treatment plants.[10/] However, municipal treatment plant operators may object to accepting runoff for treatment, fearing the potential for system overloads. Presently, San Francisco is the only municipal system with a combined sewage and storm drain system (which, as noted, often overwhelms San Francisco's treatment capabilities during storms).

Preventing pollutants from reaching runoff waters may be more cost-effective than treatment. Covering oil, chemical, and waste storage and use areas eliminates their runoff problems. A large portion of pollutants in urban runoff come from high-use areas such as parking lots and busy streets. Aggressive street-sweeping programs for these sources may be able to significantly reduce their oil and grease, and lead loadings.[11/] However, present street-sweeping devices inefficiently remove the fine-grained dirt particles that carry the bulk of pollutants, so effective sweeping would require new or modified equipment.

Cleaning streets and catch basins are major parts of local management plans to control runoff that were prepared in the late 1970's as part of ABAG's San Francisco Bay Area Management Program. However, most local governments, due to budget limitations, have reduced significantly the frequency of street sweeping and catch basin cleaning.

Alternative treatment strategies, such as using greenbelts and wetlands to biologically treat polluted runoff, may also prove effective and affordable control strategies. Use of man-made marshes for biological treatment must be carefully planned, however, so that areas used for treatment do not themselves become polluted. For this reason, existing high quality wetlands should not be used for runoff treatment projects. ABAG is now testing the effectiveness of a newly created marsh to remove pollutants from runoff waters in Fremont, Alameda County.

Siting of runoff discharge points to avoid areas with poor water dispersion and/or important and sensitive biological resources can also help reduce the adverse impacts of runoff.

Pollution from urban runoff poses an important and difficult problem. Its solution will require integrated control programs that use a range of techniques, from educational programs, to treatment devices. The section on regulation addresses the Regional Board and EPA runoff programs.

2. Erosion and Sedimentation. Sediments contained in surface runoff can degrade water quality, bury shellfish beds and fish spawning grounds, and hasten destructive soil buildup in marshes. Excessive sediment loads usually come from erosion due to removal of protective vegetation, often by agricultural or construction activities. The construction needed for projected Bay Area growth, could release tremendous volumes of sediment to reach the Bay and its tributaries. While much of this construction will occur outside of the Commission's jurisdiction, certain projects within the Commission's jurisdiction could have significant localized effects, especially on shellfish beds and shallow areas such as marshes.

To control erosion, ABAG instituted a surface runoff program, as mandated by Section 208 of the federal Clean Water Act. ABAG's program included a Manual of Standards for Surface Runoff Control Measures that contains detailed, practicable measures for erosion control. ABAG's 208 program is predicated on establishment of erosion control programs by local governments. Despite ABAG's assistance, however, some local governments have not adopted such programs. In 1982 the Regional Board amended the Basin Plan to make local governments responsible for controlling erosion and sedimentation, and to require adoption of an effective program by July 1, 1983. The 1986 amendments to the Basin Plan indicate that twelve cities and four Bay counties have yet to institute effective erosion and sedimentation control programs and recommend toughening the Board's enforcement of its requirements.

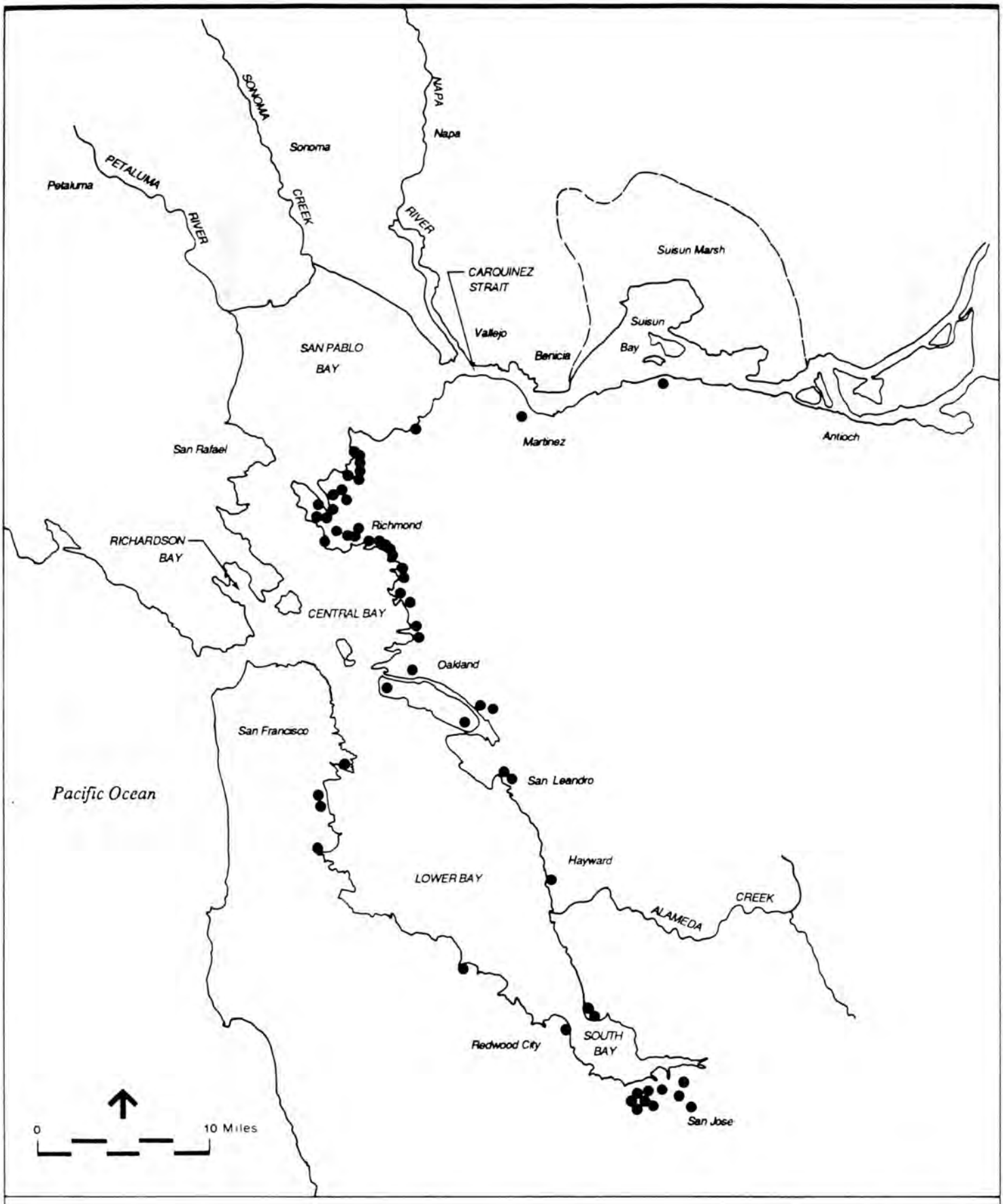
3. Tributary Inflow. Inflowing water from the Delta and other Bay tributaries is crucial to flushing the Bay's waters and maintaining existing salinity levels, and thus is the life blood of the San Francisco Bay estuarine system. However, this water is also estimated to be the largest source of sediments and heavy metals pollutants to the Bay, as well as contributing significant amounts of other pollutants (see Figure 3, page 18). However, because these pollutants are at low concentrations in Delta inflow, their impact on the Bay cannot easily be determined.

Delta waters bring pollutants to the Bay from upstream sources covering 40 percent of California's land mass, including municipal and industrial discharges, urban runoff, and, prehaps most importantly, agricultural runoff. These waste discharges are regulated by the Central Valley Regional Control Board. All of the extensively farmed Central Valley

drains to the Bay and agricultural runoff is a significant component of Delta outflow. For example, fully 20 percent of the total San Joaquin River flow consists of agricultural wastewater.[12/] Agricultural pollutants include pesticides, biostimulants, sediments, salts, and trace elements. Construction of the proposed San Luis Drain would increase inflow of these pollutants to the Bay significantly, by delivering irrigation runoff from up to 405,000 acres of the San Joaquin Valley. The contamination of Kesterson Reservoir appears to have dealt a mortal blow to the Drain, but even if it is never built, agricultural pollutants from the Delta and other Bay tributaries will continue to flow into the Bay.

4. Toxic Wastes. Pollution from toxic waste is one of the nation's most pressing environmental problems, and is no less of a concern in the Bay Area. Toxic sites often result from careless or intentional dumping of toxic substances, or the contamination of areas where these chemicals were used. Toxic wastes sites, often long abandoned and undetected, have contaminated soils, groundwaters, and surface waters in many parts of the country. While very little Bay fill has been found to contain toxic material, many toxic waste sites have been identified along the Bay shoreline and nearby lands (Figure 7, page 48 and Appendix A). It is probable that many of these sites have leaked toxicants to the Bay.

These toxic sites are subject to control at the state level by the Department of Health Services (DHS) and the Regional Board, and at the federal level by the EPA. (See Chapter III for more discussion of toxic waste regulation). While the DHS runs the state superfund program, the Regional Board is the lead agency for abating toxic sites that pose a threat to waters of the Basin.



SOURCE: Department of Health Services, San Francisco Bay Regional Water Quality Control Board, 1986

FIGURE 7

Toxic Site Locations Close to San Francisco Bay

Those sites that have been documented by state or federal authorities to pose a significant threat to human health or sensitive environments are included on their respective "superfund" lists that set priorities for abatement. The state and federal funds provided in these programs are used to contain and clean up sites that are not being abated by their owners. The federal superfund program ranks sites based on their threats to humans and the environment. The state superfund list is more complex and is actually composed of three sub-lists: (1) sites where the owner voluntarily enters into a cleanup agreement with the state; (2) sites for which the state is preparing cleanup plans, without voluntary compliance by the owners; and (3) sites to be abated by the state. Many confirmed toxic sites listed in the state's Revised Expenditure Plan (May 1986), do not fit into any of these categories, such as sites whose remedial plan is still under negotiation or that are being cleaned up by federal agencies.[13/] For the purposes of this report such sites are considered a fourth sub-list of the state superfund.

The state ranking of sites for cleanup differs from the federal ranking. The state divides the threat value derived for each site by its estimated cost of cleanup, to arrive at a benefits/cost ranking. The rationale for this approach is to maximize the public health return per dollar spent. This prevents all the state's funds from being spent only on the few largest sites, but also may give dangerous sites a lower priority if their cleanup costs are high. Thus, the worst sites may not receive the highest rankings.

The federal superfund lists eight Bay Area sites and proposes an additional 13 sites for inclusion. The latest state superfund list (May, 1986) contains at least 76 Bay Area sites (of 241 state sites). The Regional

Board lists an additional 30 sites under investigation. The state Department of Health Services (DHS) lists 23 state superfund sites as being on or near the Bay (see Appendix A). The federal list includes three of these: Liquid Gold in Richmond, Zoecon in East Palo Alto, and a large part of Alviso. Past oil recycling at the Liquid Gold site has left a variety of toxicants, including waste oils, poly-chlorinated biphenyls (PCBs), and heavy metals. The Zoecon site contains pesticides and heavy metals. The Alviso landfill site is widely contaminated with asbestos. Four sites on the state superfund list, Point Isabel in Richmond (now removed), Levin Richmond Terminals in Richmond, Zoecon in East Palo Alto, and a site along the Embarcadero in Oakland, have been the subject of Bay Commission permits and are discussed in the chapter on Bay Commission regulation. The Regional Board also maintains a list of sites that it is investigating as threats to water quality.

Several military installations near the Bay, the Alameda Naval Air Station in Alameda, the Concord Naval Weapon Station in Contra Costa County, Hunters Point Naval Shipyard in San Francisco, Moffett Field Naval Air Station in Mountain View, and the Ozol Terminal jet fuel distribution center in Contra Costa County, are known to contain seriously polluted sites. Other military bases are currently under investigation. These sites had not been included in the federal superfund because federal agencies are by law responsible for cleaning up toxic sites on their property. Now, however, federal regulations have been amended to allow inclusion of federal sites. Moffett Field is presently proposed for addition to the federal superfund.

At the Concord Naval Weapons Station, portions of tidal marsh and uplands contain heavy metals that remain from industrial uses predating federal ownership and use.[14/] This site has been the subject of detailed study by the Corps of Engineers, and alternatives to abate the problem are now

under review. At Moffett Field, nine potential toxic sites are believed to contain waste oils, aviation fuel, and solvents.[15/] Site tests are now in progress and have, so far, verified contamination at four sites and seepage beyond the base's boundaries, possibly affecting the Bay. The Alameda site, currently under study, has three dump sites along the Bay that may have subjected the Bay to significant amounts of toxic pollutants.[16/] At the Hunters Point Facility, more than 20 acres of the Bay were filled with hazardous wastes including toxic liquids and radioactive radium, while past toxic wastewater discharges have contaminated adjacent Bay sediments.[17/] The Ozol Terminal has been contaminated by extensive leakage of jet fuel.

The DHS conducted a study to locate abandoned and forgotten toxic waste sites. Nevertheless, other sites probably remain to be discovered, as occurred recently in San Francisco when a toxic coal tar deposit, the legacy of a long-defunct coal gassification plant, was encountered during excavation of old Bay fill for a high-rise building at 301 Howard Street.[18/] Similarly, it is possible that proposed project sites within the Commission's jurisdiction could contain undiscovered toxic wastes.

Hazardous chemicals are now subject to "cradle to grave" regulation to insure that they are contained, transported, and disposed of in comformity to state and federal laws, as discussed in Chapter V.

5. Community Waste Disposal Sites. Prior to the creation of the Commission, numerous local dumps or land fills were founded in the Bay and on its shoreline. Pollutants from these sites caused water quality problems into the late 1960's. Today, state and local regulations have significantly decreased pollution from these sources by mandating better management of shoreline disposal sites.

In accord with the provisions of the McAteer-Petris Act and the Bay Plan policies, no new sanitary landfills have been located in the Bay or on its shoreline in the last two decades. State and federal authorities are currently studying sanitary fills to determine the extent of their contamination with household and industrial toxicants, and what threats they may pose to people and the environment. The Regional Board requires that current and former landfills around the Bay be sealed to prevent their leachate from polluting the Bay.

6. Toxic Spills. Toxic spills are a serious source of Bay contamination. Between 1973 and 1982, the Coast Guard verified spills of more than a million gallons of oil and chemicals into the Bay and Delta[19/]. Over 40 percent of this total was aviation and automobile fuel, and 83 percent was petroleum compounds. The worst single spill, caused by the collision of two oil tankers near the Golden Gate Bridge in 1971, released 84,000 gallons of bunker oil, which fouled shorelines and adversely affected wildlife.

Toxic spills can result from damaged vessels, operator errors, handling accidents at terminals, accidents involving toxics carriers on Bay shoreline highways, and even from dumping household toxicants into stormdrains.

Most spills in the Bay are small and unpredictable, but weave a shifting pattern of direct toxic contamination. Detection and cleanup of toxic spills is complicated by their unpredictability and variability in size and toxicity.

Due to increased public concern, associated pollution laws, and industry efforts, the average amount of oil spilled into the Bay appears to be decreasing.[20/] For example, the amount of oil spilled during transfer operations decreased from 30,000 gallons in 1975, to less than 2,500 gallons in 1980.

Responsibility for monitoring and cleaning up toxic spills involves many jurisdictions, from local fire departments to state and federal agencies. To provide an organized and efficient response to toxic spills, a coordinated regional spills prevention and response plan has been implemented in the Bay Area (as discussed in Chapter III). Also, petroleum refiners have established a cooperative called "Clean Bay," which maintains clean-up vessels and responds to spills in the Bay and in the central California coastal area.

7. Vessel Wastes. Sewage (human body wastes) and graywater (kitchen, bath, and shower wastes) discharged from vessels can have significant impacts on water quality and public health particularly if discharged into areas of the Bay with minimal water dispersion and flushing. Vessel wastes can cause detrimental effects on Bay water quality by (1) introducing pathogens and bacteria, (2) toxic soap residues, (3) biochemical oxygen demanding substances, (4) suspended solids, oil, and grease, and (5) biostimulatory substances such as nitrogen and phosphorus.[21/]

The Regional Board's staff conducted a study of vessel waste discharges in the San Francisco Bay area (Vessel Waste Discharge Survey, 1981), including bacteriological sampling in 23 marinas. The following conclusions were reached as a result of that study:[22/]

1. Water contact recreation coliform objectives are being violated in marinas which have houseboats (and are not well flushed). These marinas are located mainly in three areas: Alviso Slough, Redwood Creek, and Richardson Bay.

2. As a result of BCDC requirements, pumpout facilities for vessel holding tanks are located through San Francisco Bay, but several are rarely used due to poor location and/or high user fees.

3. Military vessels are not causing water quality problems because they are almost all equipped with holding tanks for both sewage and graywater, and adequate pumpout facilities exist at military

docks. The remaining vessels and shore facilities will be modified by 1984.

4. Commercial vessel discharges were briefly reviewed. No conclusion could be reached regarding the impact of commercial vessel discharges on benefical uses. Baywide coliform sampling indicates that commercial vessels are not causing a widespread water quality problems, but local problems in shellfish growing areas may occur. This potential problem is being studied as part of the San Francisco Bay shellfish Program.

The Regional Board report states "the discharge of sewage and graywater wastes to the Bay are of particular concern in crowded and confined areas, such as marinas and harbors."[23/] For this reason, in 1982, the Regional Board adopted as part of the Basin Plan conclusion No. 5 of the Vessel Discharge Survey report which states, in part:

> the most positive control of wastes from watercraft and most effective means of preventing pollution is to provide for the disposal of waste to shoreside sewerage facilities by use of holding tanks...and/or shoreside sewer connections.

Although, small discharges of vessel wastes in areas possesing adequate dispersion and flushing may have negligible affects on bay water quality, discharges in areas of poor flushing and dispersion can degrade overall water quality, impact fish and wildlife habitat, and impede water contact recreation.

8. Dredging. Dredging removes solid material from the bottom of the Bay, usually to aid safe navigation. By increasing water circulation and volume, dredging aids water dispersion and may locally improve water quality, but it can also adversely affect water quality by: (1) disrupting or killing bottom dwelling organisms; (2) releasing sediments into the water column, which disrupt aquatic life and impair their respiratory systems; (3) releasing oxygen demanding substances, that in turn reduce levels of dissolved oxygen;

(4) releasing biostimulatory substances that may induce nuisance blooms of aquatic plants; and (5) re-releasing toxicants to the Bay system that had been buried in sediments.

The U. S. Army Corps of Engineers administers the federal permit system for dredging projects pursuant to Section 404 of the CWA. Additionally, the Regional Board has the authority under Section 401 of the CWA require a pollution discharge permit for dredging, and thereby require additional studies or deny dredging, but in the past has relied on the Corps testing program.

The adverse impacts caused by Bay disposal of dredged spoils can be prevented by disposal on land, and thus is preferred under the Commission's Bay Plan dredging policies. However, the high-cost of land disposal and the lack of available upland sites results in infrequent use of this option. Ocean disposal, which may be environmentally preferable to Bay disposal, is not cost-effective in comparsion. The only approved ocean disposal site is restricted to sediments from the entrance to San Francisco Bay. Most Bay dredge spoils are now disposed at approved Bay spoiling sites, where deep water and tidal currents facilitate sediment dispersal.

The Army Corps of Engineers is presently reevaluating dredge disposal, due mainly to the increased volumes of sediments proposed for disposal and continued mounding problems at the Alcatraz site, which receives most dredged sediments. To solve the problems at Alcatraz, the EPA is working with the Corps to establish an ocean disposal site to augment Bay sites.

"Hot spots" of polluted sediments are found at or near industrial and harbor areas, where dredging is common. To detect pollutants that will be released into the water column during the dredging process, the Corps presently tests sediment samples from proposed dredge areas. Samples of

sediment are shaken in clean water, producing an elutriate which is then tested for pollutants. If significant levels of pollutants are detected, then more rigorous tests are applied and dredging may not be allowed.

However, the elutriate test is coming under increasing question as the sole criterion of sediment pollution. Despite passing elutriate testing and being dredged twice in the last decade, Lauritzin Canal in Richmond was recently found to contain organisms polluted with DDT at extremely high levels.[24/]

The difficulty with using the elutriate test as the sole indicator of sediment pollution, is that it can only register pollutants that dissolve or re-suspend out of sediments. Pollutants that are insoluble or bound to sediments will likely remain undetected. These undetected pollutants may still have the potential to cause adverse impacts in Bay organisms;[25/] for example, through uptake into the marine food-chain by sediment dwelling organisms. Therefore, it is possible that the elutriate tests will not detect pollutants that, while not readily dissolvable, can result in adverse impacts on Bay organisms.

The existance of highly contaminated Bay sediments that are spread unevenly and unpredictably through the Bay, argues for a conservative approach to dredge spoil testing. It is thus unsettling to note that the Corps' criteria for disposal in the Bay (pursuant to the Clean Water Act), are less restrictive than the Corps' ocean disposal criteria (pursuant to the Ocean Dumping Act).

Recognizing these concerns, the Regional Board's new amendments to its Basin Plan require more rigorous testing prior to all new dredging, which may include whole-sediment testing (which evaluates the actual sediments for pollutants) and bioassays (which test the sediments affects on marine

organisms), to augment elutriate testing.[26/] These test methods should reveal sediment pollutant levels and their biological effects regardless of their solubility in water.

Unfortunately, standards have not been formulatd for allowable levels of pollutants in sediments to be dredged, due to the present lack of technical information on which to base standards, forcing the Regional Board to rely on its "best professional judgement" in the interim. Finally, the high cost of disposing of polluted sediments in approved hazardous waste facilities could prove a formidable impediment to dredging polluted areas.

Conclusions

The application of water pollution control laws and investments in treatment facilities have substantially reduced discharges of pollutants to the Bay. However, despite the billions of dollars already spent on pollution controls and the efforts of pollution control agencies, the Bay remains polluted. There are numerous kinds of pollutants found in the Bay and many sources of these pollutants. The noble goal that Congress set in the Clean Water Act, of eliminating water pollution from the nation's waterways, remains to be accomplished. Yet, without the past and present pollution programs, the Bay might now be uninhabitable and unusable.

The main issues that need to be addressed are: (1) toxic pollutants--the significant sources and their present and long-term affects on Bay organisms; (2) urban runoff--implementing feasible control strategies; (3) Delta outflow--determining the levels of outflow needed to protect the Bay and the effects on the Bay of toxic materials in outflow; (4) dredging--determining what testing should be required, what levels of pollutants are of concern, and where should polluted spoils be placed?

In addressing these issues, several important questions arise: should the Bay be used as a waste disposal system? Is the Bay sufficiently polluted to affect its beneficial uses? Can society afford to eliminate water pollution entirely? Or perhaps more realistically, what percentage of our society's resources should be spent on pollution control and where should it be spent? How should the cost be distributed between the public and private sectors?

Is it appropriate to use the Bay to dispose of our wastes? Certainly it is not if the beneficial uses of the Bay are "unreasonably affected." Many would probably agree that some of the Bay's beneficial uses <u>are</u> affected by pollution, and that it will be many years before Bay pollution can be eliminated or even reduced to an acceptably minimal level. However, the remaining questions are controversial. One could point to the money dischargers have already spent on pollution control and argue that they should not be required to spend further millions of dollars until studies prove that their discharges are threatening the Bay. Further, perhaps dischargers should not be required to achieve very high levels of treatment when pollutants from untreated discharges of urban runoff far exceed the dischargers' remaining pollutant discharges.

On the other hand, by the time proof is obtained the Bay might be irreparably damaged, making it reasonable to place the burden of proof on dischargers to prove the acceptability of their discharges. There is little dispute that all sources of pollution need to be controlled and that the level of treatment should not be allowed to fall to the lowest common denominator.

As has been stated previously, much of the dilemma in choosing appropriate water pollution control strategies stems from the lack of data on the Bay and certain Bay pollutants. Despite its importance as a natural

resource and to the regional economy, the Bay has not been studied extensively or systematically enough to know exactly what effects pollutants are having on the Bay.[27/] Scientific studies have identified problems and have correlated pollutants with effects in organisms. However, these do not constitute proof--and scientists are the first to point this out. The phrase "science does not yet know," is usually followed by a call for more research; and more research is desperately needed. But it will be many years before definitive answers are found. Decisions will have to be made before then, and made despite uncertainty.

Regulating, financing, and enforcing pollution control efforts is a formidable endeavor and is largely the task of government. The state and federal water pollution control laws are undoubtedly the most influential of society's attempts to answer the questions of controlling pollution. The next chapter addresses the role played by government in regulating pollution.

CHAPTER III. WATER QUALITY REGULATION

The improvement in Bay water quality is due largely to the implementation of federal and state water pollution control laws enacted after the Commission was created and the Bay Plan was adopted. The heart of the control program is the coordinated implementation of the federal Clean Water Act and the state Porter-Cologne Act. The federal Environmental Protection Agency (EPA) and the State Water Resources Control Board and its Regional Boards have the major responsibility for controlling water pollution, augmented by various other federal, state and local agencies. This chapter discusses federal, state, and local water quality regulations with particular emphasis on the regulations that most affect San Francisco Bay.

Federal Laws

1. The Clean Water Act. The Clean Water Act (CWA) is the central law in the federal water pollution control program. Passed originally in the late 1940's, the CWA has been amended repeatedly; the 1972 amendments were the most comprehensive of these and established the current program.

The 1972 amendments to the CWA declared two national water pollution control goals: (1) elimination of the discharge of pollutants into navigable waters of the United States by 1985 and (2) attainment by July 1983 of the interim goal of water quality that protects fish, shellfish, and wildlife and provides for water contact recreation. The act declares four national policies to achieve these goals: (1) elimination of pollutant discharges in toxic amounts, (2) development and implementation of area-wide

waste treatment plans to assure adequate control of pollutants in each state; (3) provision of federal funds for waste treatement facilities, and (4) a research program to develop the technology needed to eliminate pollutant discharges.

The program to carry out these policies is complex. The CWA is administrated by the EPA, but its implementation involves several federal agencies as well as state governments. The CWA requires the states to apply and coordinate the water quality control programs established in the Act, in Regional Implementation and Management Plans. The plans for the San Francisco Bay area are: (1) the San Francisco Bay Basin Water Quality Control Plan prepared by the Regional Board and approved by the State Board, and (2) the Bay Area Water Quality Management Plan developed by the Association of Bay Area Governments. These plans are discussed later in the chapter.

The CWA divides pollution sources into two types; point and non-point. As discussed earlier, a point source is a waste stream discharged at a discrete and identifiable location, such as an outfall pipe, ditch, or channel. A non-point source is a diffuse wastewater without a discrete discharge location, such as fallout from air pollution and salt water intrusion. The main thrust of the CWA is on controlling point source discharges. Urban runoff, treated in the past as a non-point source, will now begin to be treated as a point source.

a. Point Sources. Under the CWA, point source discharge of pollutants to the Nation's navigable waters is prohibited unless a National Pollutant Discharge Elimination System (NPDES) permit is obtained. The EPA has the primary responsibility for implementing and overseeing the NPDES system but may delegate it to approved state programs. The State and Regional Boards implement the NPDES program in California.

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A crucial component of the 1972 amendments was a shift in emphasis of the CWA from discharge standards based solely on receiving water quality, to technology-based standards for discharged effluent. Prior to this shift, the CWA allowed pollutants to be discharged to receiving waters in any amount, so long as pollutant levels in those receiving waters did not exceed federal water quality standards. Now, all point source discharges are required to first meet standards based on achievable pollutant treatment technologies before they can be released to receiving waters.

In California, the permit system has been delegated to and is implemented by the State Board through its nine Regional Water Quality Control Boards. The San Francisco Bay Regional Board conducts the permit system in the Bay basin (see Figure 1, page 9). To implement the technology-based approach of the CWA, the EPA adopted treatment standards for each category of industry based on the Best Available Technology (BAT) for treating that industry's wastes. For municipal sewage treatment plants, the CWA mandated standards based on secondary treatment of wastes. The NPDES permit issued for each point source will be based on the technological standards for that source, as well as any effluent limitations based on the water quality of the receiving waters.

The 1972 CWA amendments also mandated "pre-treatment" programs to prevent waste from passing through or damaging municipal treatment systems. In 1977 the CWA was again amended, providing more stringent pre-treatment standards. Under the program, the EPA was required to establish two types of national pre-treatment standards. Prohibited Discharge Standards limit the introduction of pollutants that will damage treatment works or be

passed through them. Categorical Pre-treatment Standards limit discharge of specific toxicants in specific industrial categories and are based on BAT. EPA regulations direct the states to develop pre-treatment programs to meet the standards. The EPA has established most categorical standards and is now establishing compliance schedules. California is in the process of having its pre-treatment program approved by the EPA.

b. Research and Funding. Recognizing that the elimination of water pollution would require informational and technological advances, and an enormous investment in upgraded treatment systems, the CWA established research and construction funding programs. The EPA administers an ongoing research program which provides the technical basis for effluent and receiving water standards and discharge permit compliance schedules. The CWA provides most of the funding to construct municipal treatment facilities required by these standards, with state and local governments normally providing the remaining funding. Additionally, the EPA has recently included the San Francisco Bay in its National Estuarine Program (NEP), which has been established to forcus on the special needs and problems of the Nation's estuarine systems. The 1986 Clean Water Act amendments that were passed unanimously by Congress would have substantially enlarged this commitment by doubling NEP funding to 12 million dollars, and making San Francisco Bay a priority project. However, the President subsequently vetoed the legislation.

c. Non-Point Sources. Because many sources of pollution, such as urban runoff, cannot be effectively controlled at a discrete discharge location they require broad-based pollution control strategies. The CWA requires states to include control strategies for non-point pollution in their regional management plans (these plans are discussed later). The CWA directs the EPA to provide the states with the information and guidelines necessary to prepare these strategies.

In the past, urban runoff has been treated solely as a nonpoint pollution source. However, storm drains, ditches, and canals that transport polluted urban runoff to receiving waters can be identified as point sources under the CWA. The EPA is now moving, in a phased approach, to regulate point discharges of runoff from urban areas. Dischargers of runoff in these areas will have to obtain permits that, at the least, will require pollutant testing.

Other specific sources of pollution are singled out in the act for special planning and permit requirements, which involve federal agencies other than the EPA. Particularly pertinent among these to San Francisco Bay are discharge of dredged and fill materials, oil production and transportation, and marine sanitation devices.

d. Discharge of Dredged and Fill Materials. Under Section 404 of the CWA, disposal of dredged material and placement of fill in navigable waters, including wetlands, is regulated through a U. S. Army Corps of Engineers permit system, and material that is seriously polluted cannot be discharged into navigable waters. Disposal of dredged material to the ocean is covered by a different law (see other federal laws).

e. Oil Production and Transport. Section 311 of the CWA regulates the handling and transport of oil and other hazardous substances on vessels and at offshore and onshore production facilities. Discharge of any of these materials in waterways is prohibited, and dischargers are held liable for cleanup and penalties. This program is administered by the U. S. Coast Guard, in consultation with the EPA.

f. Marine Sanitation Devices. Section 312 of the CWA provides for the regulation of discharges from marine toilets on vessels. Generally, any vessel with a toilet must be equipped with a Coast Guard approved marine sanitation device (MSD). The Coast Guard's MSD regulations were developed in

accord with EPA performance standards. Although the regulation of sewage discharges from vessels is largely reserved to the Coast Guard, Section 312 expressly authorizes EPA, on state request, to prohibit vessel discharges in areas where discharge would cause signifiant adverse water quality impacts if adequate alternative provisions for the safe disposal of vessel sewage are available, such as vessel sewage pumpout stations. Federal law does not, however, preempt state control of greywater (shower and galley wastewater) from vessels.

2. Other Federal Laws. A number of federal laws besides the Clean Water Act address water quality issues. The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) was enacted in 1980 to protect the public and the environment from toxic pollution threats posed by hazardous waste sites. CERCLA established the National Priorities List to identify the worst toxic sites and the federal superfund to finance their control and cleanup. The law also established the basic liability of the site owner or operator to reimburse the government for costs of cleanup actions.

The Resource Conservation and Recovery Act (RCRA), passed by Congress in 1976, is intended to prevent hazardous chemicals from becoming pollutants and is structured much like the CWA. Under the RCRA, the EPA identifies hazardous chemicals and develops standards and regulations governing their generation, transport, storage, and disposal. The RCRA also established a permit system for regulating hazardous chemicals which can be delegated to approved state programs. The California Department of Health Services has functionally assumed portions of the RCRA system and has applied for its full delegation. Finally, states are required to develop comprehensive solid waste management plans, aided by EPA research and funds. The California Solid Waste Management Board is responsible for approving local government solid waste management plans in California.

The disposal of any dredged material to the ocean is regulated by the Marine Protection Research and Sanctuaries Act of 1972 (Ocean Dumping Act). The criteria to analyze proposed spoils for pollutants pursuant to the Act are stricter than the Corps 404 criteria and even materials being transported for disposal in international waters are subject to the Act's provisions.

State Laws

1. The Porter-Cologne Act. The Porter-Cologne Water Quality Control Act is the major California law governing water pollution. Passed in 1969, the law has since been amended to keep the state program in compliance with the federal Clean Water Act. While structured, in part, to implement the Clean Water Act, its water quality goals, policies, and implementation programs are far more comprehensive then required by the CWA. For example, while the CWA's jurisdiction is limited to navigable waters, the state's jurisdiction under the Porter-Cologne Act includes groundwater resources.

The Porter-Cologne Act is administered by the State Board and carried out largely by the Regional Boards. Under the Porter-Cologne Act, the state program closely parallels the federal program. The State Board formulates and adopts state policy for water quality control in conformity with the policies set forth in the Act. The Regional Boards conduct the planning, permit, and enforcement activities under State Board guidelines and oversight. Both the state and regional boards are authorized to establish water quality standards that will protect the beneficial uses of the state's waters as set forth in the Act. (For a more detailed discussion of benefical uses and the San Francisco Bay Basin Plan see page 70). The Act establishes a state counterpart to the federal funding assistance program for construction

of needed public treatment works, administered by the State Board. To help identify potential ground water problems, the Act requires the State Board to identify buried hazardous waste tanks. Several provisions of the Act are particularly relevant to the Bay:

a. Highest Priority for Estuaries. Estuaries are among those waters given the highest priority for improving water quality. Pursuant to this provision, the State Board adopted a policy for bays and estuaries calling for ocean discharge of municipal wastewater where feasible, elimination of waste discharges to the extreme south of San Francisco Bay, and additional research and control of toxic discharges to the Bay-Delta system.

b. Houseboats. The law directs local governments to regulate discharges from houseboats, and if a local jurisdiction fails to adopt adequate ordinances, the law directs the Regional Board to adopt its own regulations and require the local jurisdiction to enforce them.

c. San Joaquin Valley Agriculture Drainage. The law specifically prohibits discharge from a San Joaquin Valley agricultural drain to the Delta, Suisun Bay, or the Carquinez Strait until both state and federal water quality standards can be met.

2. Other State Laws. The State Water Code gives the State Board the authority to regulate diversions of the state's waters for all uses, from agricultural to municipal supplies. Thus, in addition to overseeing regulation of the state water quality program, the State Board is also in charge of allocating water rights. Sections 1243 et seq. of the Water Code require the State Board to balance the needs of existing in-stream beneficial uses in considering allocations of water rights and the public trust. Additionally, the State Court of Appeals recently clarified the State Board's obligation to maintain the beneficial uses of the Bay and Delta when

considering allocations of water rights. The court ruled that, beyond mitigating the adverse effects of further water diversions on downstream beneficial uses, the State Board is entitled and compelled to adjust both water quality standards and all existing and proposed water appropriations to a level that will insure protection of downstream beneficial uses.[1/] In early 1987 the State Board will commence hearings to reconsider water quality standards for the Bay/Delta system. In light of the court's ruling, the State Board may reserve additional freshwater inflow to protect beneficial uses of the Bay/Delta system.

Several state laws other than the Porter-Cologne Act address specific water quality issues. Section 8574.1 of the California Government Code authorizes the establishment of a statewide oil spill response plan coordinated by an interagency team, with the Department of Fish and Game responsible for responses to on-water spills. Section 8574.7 of the Government Code requires the formulation of a toxic disaster response plan. Section 5650 of the Fish and Game code prohibits the discharge of certain materials to state waters. The Solid Waste Management and Resources Recovery Act regulates solid waste disposal. The Hazardous Waste Control Act establishes the authority of the Department of Health Services to identify, list, and specify management and abatement measures for hazardous waste sites. The Harbors and Navigation code sets standards and procedures for handling petroleum and regulates vessel sewage discharges to the degree that these standards would not conflict with federal regulation of the design, manufacture and use of marine sanitation devices (MSDs).

Regional Laws and Plans

1. Local Government. A variety of ordinances passed by cities, counties, and special districts affect the control of water pollution. County health codes regulate sewage disposal and the safety of drinking water. Special districts operating treatment plants often issue regulations governing the discharge of substances into their facilities. Some communities have passed ordinances regulating sewage discharge from houseboats. Many have adopted erosion control ordinances in an attempt to control non-point source discharge. Flood control and water districts will often issue regulations prohibiting the pollution of water courses within their districts.

2. The Comprehensive Water Quality Control Plans for the San Francisco Bay Area. There are two important regional water quality control plans for the Bay. Both fulfill requirements of the CWA, and implement both the state pollution control program (Porter-Cologne Act) as well as the federal CWA program.

a. The Basin Plan. Officially titled the "San Francisco Bay Basin Water Quality Control Plan," the Basin Plan is the comprehensive plan prepared by the Regional Board to apply state and federal water pollution control laws in the context of the actual water quality conditions in the region. The Basin Plan specifies the various receiving waters in the basin, their beneficial uses, water quality objectives to protect the beneficial uses, and implementation programs to achieve those objectives. It also provides a basis for disbursing state and federal funds for treatment facilities and includes monitoring and research programs.

The Regional Board's jurisdiction encompasses the entire hydrologic drainage, or basin, of the San Francisco Bay Area (See Figure 1, page 9), excluding the Central Valley and including its streams, lakes,

wetlands, groundwaters, bays, and the ocean. The Basin Plan divides the basin's waters into fifteen principle receiving segments that are defined by similarities in assimilative abilities and beneficial uses. The San Francisco Bay constitutes six of these segments. The segments are ranked according to their relative water quality to help prioritize control strategies in the basin.

The Basin Plan defines the beneficial uses of each water segment. These include natural uses, such as fish and wildlife habitat, industrial uses, and recreational and aesthetic uses.

Water quality objectives are formulated to protect the beneficial uses of the basin's waters and to enforce the state and federal policies that existing high-quality waters not be degraded. These objectives are separately defined for ocean, inland, and ground waters, and consist of either qualitative or numerical standards.

The implementation plans to achieve these objectives cover a range of strategies. Discharge prohibitions apply to substances of concern within the entire basin, while individual point source discharges receive National Pollutant Discharge Elimination System (NPDES) permits which are tailored both to the characteristics of the point source (technology based limits) and its receiving segments (water quality based limits).

Control measures are addressed in the Basin Plan for erosion, urban runoff, oil spills, dredging and other non-point sources of pollutants (see Basin Plan amendments below).

The Basin Plan also lists the remaining improvements that need to be made to municipal treatment facilities. In addition, it describes the Board's surveillance and monitering program and various State Board policies including those regarding the San Luis Drain, domestic solid waste disposal, toxic wastes and hazardous materials, and wet weather overflows.

The Basin Plan is meant to be revised every three years to keep it current. In the current updating process, the Regional Board staff has proposed major revisions to the Basin Plan. These amendments include: (1) stricter water quality objectives for toxic pollutants; (2) development of discharge requirements based on waste load allocations for individual receiving segments; (3) "local effects monitoring programs" to gather information needed to implement the water quality based approach; (4) stronger protection of wetlands, (5) reevaluation of dredge disposal policy; and (6) an urban runoff management program that involves point and runoff dischargers in sub-regional studies of local runoff problems that are meant to lead to appropriate control measures.

b. The San Francisco Bay Area Environmental Management Plan (EMP). This plan and recommended program was prepared by ABAG in 1968 for the purpose of coordinating the control of of air, water, and solid waste problems in the Bay Area. The EMP fulfills the requirements of Section 208 of the CWA which require the preparation of areawide water quality management plans. The water quality programs contained in the EMP are primarily designed for implementation by local governments and emphasize the development of measures for the control of non-point sources of pollution. Although ABAG provides technical assistance to local governments to develop such measures, there is no requirement that local governments actually adopt and implement them.

The heart of the EMP is a series of policy statements with recommendations for specific implementation actions. For each action, the plan identifies the agencies that should implement the action, the legal authority, suggested implementation schedules, costs, financing mechanisms, and measures necessary to ensure implementation.

Among the EMP's major water quality recommendations is the formation of a research advisory council. This recommendation, in concert with initiatives of the State and Regional Boards, led to the establishment of the Aquatic Habitat Institute, whose primary mission is to conduct and coordinate scientific research needed to provide the technical basis for water quality regulations. The Commission appoints one member of the Institute's board of directors.

The EMP also recommends establishment of a program to monitor and patrol shellfish beds to permit the safe re-opening of shellfish harvesting in the Bay. For surface runoff, the EMP calls for the implementation of county surface runoff plans which incorporate the use of 17 major control measures ranging from improving street sweeping practices to developing public education programs.

The Basin Plan and the EMP both address water pollution management in the Bay Area, but approach it with differing emphasis and strategies. The Basin Plan is the Regional Board's plan of action and is implemented through its regulatory powers under state and federal laws. The EMP is meant to coordinate the actions of various agencies and emphasizes control of non-point pollution sources. The implementation of this plan depends on the voluntary actions of local government.

The Regional Board is responding to concerns about the health of the Bay through the changes to the Basin Plan identified above and by partial funding of research efforts of the Aquatic Habitat Institute. The Environmental Protection Agency is providing technical guidance to the Regional Board in its efforts and should be providing more specific information on the Bay through the National Estuarine Program.

The general approach of the state and federal pollution control laws has been to treat, or require treatment of, the pollutants produced by society. In certain instances, such as the treatment of urban runoff during winter storms, this approach appears to be prohibitively costly. Thus, the Regional Board has been moving towards integrated control programs. Further, in the absence of proven disposal technologies, cleanup of toxic waste sites often merely moves the toxic wastes from one location to another. One possible way to reduce toxic pollution could be the adoption of production techniques and land use regulations that control the production of toxic pollutants. However, outside of banning the use of certain chemicals such as DDT, past governmental pollution control programs have mostly affected the production of pollutants indirectly, through making their use more costly.

CHAPTER IV. CONCLUSIONS

The San Francisco Bay, like most urbanized estuary systems, has experienced serious water quality problems. While regulation and an ambitious public works program have largely corrected the previously extensive pollution of the Bay's waters, the Bay still faces serious threats to its water quality. This chapter reviews the Commission's authority for involvement in Bay water quality matters, past Commission policies and actions in regards to water quality, and recommends how the Commission might best address present and future water quality problems.

The Clean Water Act and the Porter-Cologne Act designate the Environmental Protection Agency (EPA), the State Water Resources Control Board (State Board), and the Regional Water Quality Control Boards (Regional Boards) as the principal agencies to implement the state and federal water pollution control programs. The Commission, however, has an important and continuing role in restoring and maintaining the water quality of the Bay. The Commission's greatest contribution to Bay water quality, undoubtedly, is through preventing excessive and unnecessary fill in the Bay and by expanding the Bay's surface area and volume through the return of diked areas to tidal action. These actions have preserved and actually increased the Bay's tidal prism and acreage of tidal marsh, which in turn have preserved pollutant dispersion and flushing in the Bay system and its ability to biologically assimilate pollutants. Further, the Commission presently has water pollution findings and policies in the Bay Plan and has addressed various water quality impacts in considering individual permit applications, in order to reduce the amounts of pollutants entering the Bay system and adverse effects on the Bay's beneficial uses.

Water Quality Authority

The Commission's authority to address water quality impacts of projects proposed in its jurisdiction is fairly general and is set forth in Sections 66600, 66603, 66605, and 66632(f) of the McAteer-Petris Act. Section 66600 states the Legislature's finding that the "public interest in the San Francisco Bay is in its beneficial use for a variety of purposes...and that the Bay operates as a delicate physical mechanism in which changes that affect one part of the Bay may also affect all other parts. It is therefore declared to be in the public interest to create a politically responsible, democratic process by which the San Francisco Bay and its shoreline can be analyzed, planned and regulated as a unit." In Section 66603, the Legislature further finds and declares that the Commission, treating the entire Bay as a unit, has made a detailed study of all the characteristics of the Bay, including Bay water quality, and prepared the comprehensive and enforceable Bay Plan to guide the Commission's future permit actions. The Commission is required, by Section 66605, to issue a permit for a proposed project if the project is either: (1) necessary to the health, safety, or welfare of the public in the entire Bay Area, or (2) consistent with the provisions of the McAteer-Petris Act and policies of the Bay Plan. Further, Section 66605 of the Act provides that the Commission may only authorize fill for a project if the following condition is met:

> the nature, location and extent of any fill should be such that it will minimize harmful effects to the bay area, such as, the **reduction or impairment of** the volume, surface area, or circulation of water, **water quality**, fertility of marsh or fish or wildlife resources; (emphasis added)

To ensure project consistency with the McAteer-Petris Act and the Bay Plan policies, the Commission is empowered to grant permits subject to

reasonable terms and conditions (Government Code Section 66632(f)). Thus, in issuing permits for projects in its jurisdiction, the Commission may place reasonable conditions in a permit concerning water quality consistent with the Commission's Bay Plan water quality policies and the water quality provisions of the McAteer-Petris Act.

The Bay Plan policies on water pollution currently state:

1. To the greatest extent feasible the remaining marshes and mudflats around the Bay, the remaining water volume and surface area of the Bay and fresh water inflow into the Bay should be maintained.

2. Water quality in all parts of the Bay should be sufficiently high to permit water contact sports and to provide a suitable habitat for all indigenous and desirable forms of aquatic life. It is assumed that this will be achieved, in time, as the result of measures taken in response to requirements and enforcement proceeding of the Regional Water Quality Control Board, and measures resulting from current governmental studies (Because of the work of these agencies, this Commission has not dealt extensively with the problem of pollution control. But the entire Bay Plan is founded on the belief that water quality in San Francisco Bay can and will be maintained at levels sufficiently high to permit full public enjoyment and use of the Bay.)

3. The water quality laws and practices should insure that no project is built within the watershed of San Francisco Bay unless its liquid wastes will be treated, on the premises or in a public treatment plant having sufficient capacity, so that the effluent would not cause delay in compliance with applicable water quality standards anywhere in the Bay.

The Bay Plan water pollution findings and policies have not been amended since the Plan was adopted by the Commission in 1968, prior to the establishment of the present state and federal water quality control programs and at a time when the future direction of those programs was not clear. Consequently, the generality of the policies reflect that uncertainty.

The McAteer-Petris Act and the Bay Plan policies give the Commission authority to consider and condition the water quality impacts of Commission

approved projects. Additionally, certain kinds of solid pollutants could arguably be defined and regulated as fill under the Commission's law and policies. However, because the Regional Board, the EPA, and other agencies have greater technical resources and regulatory authority to address water quality issues, the Commission has relied on these agencies to take the lead in regulating the water quality impacts of proposed Bay projects.

The federal Coastal Zone Management Act, under which the Commission's coastal management program was approved in 1978, provides that:

> Notwithstanding any other provision of this title, nothing in this title shall in any way affect any requirement (1) established by the Federal Water Pollution Control Act, as amended, or the Clean Air Act, as amended, or (2) established by the Federal Government or by any state or local government pursuant to such Acts. Such requirements shall be incorporated in any program developed pursuant to this title and shall be the water pollution control and air pollution control requirements applicable to such program. (Section 307(f))

This section was included in the federal coastal law to ensure that states do not use the "federal consistency" authority provided to states by the Act to authorize projects that do not meet the applicable federal water and air quality standards. Under this authority, California's air and water quality standards can be applied to federal projects by the Commission. In addition, the Commission can, under its McAteer-Petris Act authority, independently consider the water quality impacts on the Bay of private and local and state agency projects.

Coordination With Other Agencies

The Commission works closely with other agencies to optimize Bay water quality. Section 66632(e) of the McAteer-Petris Act requires that a copy of each Commission permit application be sent to the Regional Board for review and comment. The Regional Board is required to file a report with the Commission within 60 days indicating the effect of the proposed project on Bay water quality. This process is intended to assure a close working relationship between the Commission and the Regional Board and to ensure that the Commission considers the Regional Board's recommendations concerning water quality aspects of Commission permit applications.

In addition, the Commission has worked with the Corps of Engineers to minimize the impacts of dredging and spoil disposal, and with the Regional Board to control sewage from recreational boats in Bay marinas and the unnecessary production of water turbulance during project construction that would increase the amount of sediments suspended in Bay waters.

Because the State and Regional Boards concentrate on point sources, the Commission can best address point source pollution through participation in the State and Regional Board's planning and NPDES permit proceedings. However, water quality impacts associated with projects proposed within the Commission's jurisdiction can and should be addressed in the Commission's permit process, especially impacts from non-point sources, such as erosion and urban runoff, relying on the technical advice of the Regional Board and the EPA. Therefore, by including specific water quality permit conditions that also help implement the water quality standards of the Regional Board, the Commission can work with the Regional Board to protect the beneficial uses of the Bay.

Dredging

The McAteer-Petris Act and the Bay Plan require that the Commission minimize the adverse water quality impacts of dredging projects. These impacts can range from temporary turbidity during routine maintenance dredging and spoiling, to major releases of toxicants if highly contaminated sediments are dredged. Unfortunately, the Commission does not have the technical expertise or resources to monitor and evaluate toxicity testing of dredge spoils. While concerned with the effects of dredging on water quality, the Commission has properly relied on the Regional Board and the EPA to advise it on water quality issues, and should continue to do so.

However, given the concerns about the water quality impacts of dredging raised in the pollution sources section, the Commission should take a more prominent role to ensure that the significant unavoidable adverse impacts of dredging are lessened. This can best be accomplished by requiring (1) environmental review of proposed dredging projects to address possible effects caused by any significant sediment pollution of dredging and (2) testing adequate to reveal significant levels of pollutants and probable effects on Bay organisms of all sediments proposed for dredging, as specified by the Regional Board and the EPA. Because significant levels of pollutants in sediments have been found in areas that have already been dredged, testing should therefore extend to both new and maintenance dredging. Because pollutants are not evenly distributed in Bay sediments and to minimize testing costs, a tiered system should be employed that requires more extensive testing where contamination is suspected or has been revealed by initial tests.

The Commission should ensure that all dredging it approves is consistent with the requirements of the Regional Board and the EPA.

More generally, the Commission should support the Regional Board's decision to maintain an active role in testing and evaluating proposed dredging. The Commission should aid the Regional Board and the Corps in minimizing adverse dredging effects to the extent possible.

Toxic Sites

Several toxic waste sites on or near the Bay have been involved recently in the Commission's permit process. Four of these sites have been or are state superfund sites; Point Isabel in Richmond, Levin Richmond Terminals in Richmond, Zoecon in East Palo Alto, and a site along the Embarcadero in Oakland.

The Point Isabel site was contaminated by high levels of lead and zinc that leached from waste batteries dumped along the shoreline. The present land owner, Santa Fe Land Company, received a Commission administrative permit in 1985 to cleanup the site.[1/] The actual cleanup process has been completed and constitutes one of the more successful toxics cleanup efforts in the state, if not the nation.

The Levin Richmond Terminal Corporation received an administrative permit in 1986 to place riprap along the shoreline and a semipermeable membrane and gravel cover in the shoreline band at the Parr-Rich Canal in the Richmond Inner Harbor.[2/] This area was part of the United Heckathorn superfund site contaminated with lead and DDT. The permit allowed implementation of a Regional Board and DHS approved plan to safely seal the pollutants and allow the site to be used for industrial purposes, resulting in DHS removal of the Parr-Rich Canal portion from the United Heckathorn site listing.

The Port of Oakland, after receiving a major permit from the Commission in 1980 for redevelopment work, found PCB contaminated groundwater in the Embarcadero area.[3/] While the cleanup has delayed installation of public access required in the Port's permit, there is little danger of the contamination affecting the Bay or nearby residents.

Zoecon Corporation has applied for an administrative permit to drill several groundwater monitoring wells in the Commission's jurisdiction, pursuant to state and federal cleanup plans for its East Palo Alto site, which is on both state and federal superfund lists.[4/]

Although not listed as a superfund site, Stauffer Chemical in Martinez received a major permit in 1976, which was amended in 1979, to cleanup a toxic cinder pile resulting from the manufacture of sulfuric acid. [5/] The permit authorized a permanent levee to prevent contaminated groundwater from leaching into the Carquinez Straits. This cleanup plan was approved by the Regional Board, although Stauffer was fined $50,000 by the Regional Board for subsequently allowing large amounts of leachate to enter the Bay.

The Commission's permit process does not have, beyond its normal permit review procedure, any special method for reviewing sites contaminated with toxic wastes. As part of all permit applications, however, the Commission presently requires applicants to indicate any necessary approvals from the Regional Board, or other agencies, and copies of all proposed permits, as discussed earlier, are sent to the Regional Board for review.

While it is neither necessary nor appropriate for the Commission to take the lead in regulating toxic sites within its jurisdiction, it is important that the Commission be fully informed about the status of these toxic sites, especially those that are the subject of Commission permits. Therefore, the Commission's staff should monitor information about toxic sites within its

jurisdiction. Maps of current toxic sites under investigation by the Regional Board, the state Department of Health Services, and the EPA are included as Appendix A to this report. It is also possible that a contaminated site that has not been identified by state and federal authorities could be the subject of a Commission permit application. The permit process should be refined to include reasonable steps for identifying such sites. For example, applicants should be required to disclose, as part of their permit application, information about toxic sites involved in their project and historic uses of the project site.

Further, the Commission's permit requirements should be consonant with state and federal cleanup plans for toxic sites. For example, it would be highly inappropriate for the Commission to require public access in an area that might expose the public to toxic wastes, or to return contaminated sites to tidal action. Permit applications involving toxics should be called to the attention of the Regional Board, the EPA, and the California Department of Health Services for focused review. The Commission should work closely with the appropriate regulatory agencies to assure that Commission permits will further the expeditious cleanup of polluted sites and will not endanger people or the environment. If on-site toxics preclude public access at a project site, then in-lieu public access should be considered until the site is cleaned up.

The Commission has also issued permits for the operation, closure, and subsequent development of municipal and industrial sanitary landfills. Sanitary landfills sited near the Bay pose many problems because: (1) they often fill low-lying areas that are seasonal wetlands or areas that could be returned to tidal action, thus reducing the potential to increase the Bay's volume and ability to assimilate pollutants; (2) leachate from landfills is

usually toxic and contaminated with long-lived pollutants, which pose threats to the Bay for long periods; and (3) the hazardous nature of sanitary landfills seriously limits their potential for future development. The Commission's existing policy against siting sanitary landfills near the Bay recognizes their problematic nature. The Commission should treat applications involving sanitary landfills with the same cautious approach as toxic sites, for, in a very real sense, they may be toxic sites.

Vessel Wastes

The Regional Board has specifically requested the Commission to help control vessel waste discharges. The Regional Board's Basin Plan states:

> The discharge of waste from pleasure, commercial, and military vessels has been a water quality concern of the Board since 1968 when Resolution No. 665 was adopted, suggesting that the Federal government regulate waste discharge from vessels. In 1970, the Board adopted two more resolutions, 70-1 and 70-65, on vessel wastes. **The first urged BCDC to condition marina permits for new or expanded marinas to include pumpout facilities, dockside sewers, and restroom facilities.** Resolution No. 70-65 also recommended that vessel wastes be controlled in such a manner through legislative action. (Emphasis added)

A variety of methods enable the Commission to reduce or eliminate the adverse impacts of sewage and graywater released from vessels moored or docked in the Bay. These methods include: (1) requiring vessels that use marina berths and commercial docking facilities authorized by the Commission to conform with U. S. Coast Guard MSD regulations (sewage treatment); (2) requiring marinas to provide convenient upland restroom and shower facilities for boater use; (3) requiring marinas to provide free or low-cost easily accessible pumpout facilities for use by boaters; and (4) providing public education programs dealing with water pollution impacts and methods to avoid discharges.

Urban Runoff

Urban runoff generates a significant and growing part of the total pollutant loadings to the Bay. Most urban runoff comes from areas outside the Commission's jurisdiction, but runoff from shoreline projects can have significant local impacts. This is because large amounts of pollutants can be generated from relatively small areas, such as parking lots.[6/] Also, near-shore areas of the Bay that have poor water dispersion or that host important biological resources, such as shellfish beds, may receive greater harm from runoff pollution. Consequently, beneficial uses of the Bay could be impaired by polluted runoff from projects within the Commission's jurisdiction, if permit conditions are not included to protect them.

Shellfish beds are especially sensitive to contamination from polluted runoff, and in recognition of this, the Regional Board has adopted Resolution No. 83-10 urging the Commission to "consider ways to eliminate or minimize new sources of dry season runoff that could contaminate shellfish beds." Therefore, to protect shellfish beds and other beneficial uses of the Bay, the Commission should consider, through consultation with the Regional Board and the EPA, the potential runoff contribution, water dispersion and flushing rates of receiving waters, and beneficial uses that may be impacted by runoff from each proposed project, before deciding what permit conditions, if any, should be required.

Conditions the Commission could require in permits to treat or prevent pollution from urban runoff include source controls to minimize or prevent contamination of runoff (such as roofing chemical and waste handling areas), onsite treatment of runoff (i.e. oil and grease separators), diversion to treatment facilities, or treatment of runoff in man-made marshes if it can be shown that pollutants would not contaminate the marsh and its wildlife. In

addition to treatment and source control of urban runoff, the Commission should consider siting runoff discharge points, whenever possible, to avoid areas of the Bay that are especially sensitive to runoff pollution.

Unfortunately, many control measures for urban runoff are presently costly or unproven, and identifying those projects that could cause significant localized impacts on water quality will often require technical determinations by water quality experts. The Commission will therefore have to work closely with the State and Regional Boards and the EPA to identify (1) projects whose runoff would cause significant impacts on the Bay and (2) technologies that could feasibly be used to treat urban runoff.

The Commission has been concerned about urban runoff and has imposed permit conditions to control it. For example Permit No. 82-22 to Benecia Industries to construct a lot, used for temporary storage of imported automobiles, included a condition that prohibited disposal of runoff to an adjoining marsh, unless the water was discharged in a manner that would prevent adverse effects. Plans for the discharge system needed specific approval of either the Regional Board or the Commission's staff engineer. The condition recognized that marshes can assimilate oil and grease pollutants, so long as the discharge is not excessive and is properly designed and located.

Construction Site Erosion and Sedimentation

Excessive sedimentation degrades water quality, buries shellfish beds and fish spawning grounds, and hastens destructive deposition in marshes. Increased rates of downstream sedimentation often follows when protective vegetation, removed by agricultural or construction activities, no longer prevents erosion.

While most sediment originates outside its jurisdiction, the Commission can control sources within its jurisdiction that would cause significant localized problems, especially in marshes.

Recognizing this, the Commission required the development of local streamside and grading ordinances to control upland erosion and marsh sedimentation in the Suisun Marsh Protection Plan, adopted in 1976.

The Commission should continue to support the efforts of ABAG, the Regional Board, and local governments, to control erosion and sedimentation in the Bay Basin, and it should continue to address potential sedimentation problems in individual projects. Specifically, for those projects that pose potential sedimentation problems, the Commission should include erosion and sediment control measures as permit conditions, using applicable provisions of ABAG's Manual of Standards of Erosion and Sediment Control Measures and preventing grading in the shoreline band during the rainy season (October 15-April 15) except when the Commission determines that the work will not significantly increase sediment discharge from the project site.

Proposed Changes to the Bay Plan

To assist in achieving a high degree of Bay water quality, the Commission should incorporate new findings and policies into the Bay Plan consistent with the above information. These findings and policies would change the present water pollution findings and policies, add new findings and policies to the dredging and recreation sections, and add a new major conclusion and policy on water quality to the summary section of the Bay Plan.

Water Pollution

The staff believes the existing Bay Plan water pollution findings and policies should be amended to incorporate the new information developed on Bay water pollution, sources of pollution, and pollution control included in this report.

1. Finding "a." Finding a. (page 8) now states:

> a. San Francisco Bay receives a variety of municipal, industrial, and agricultural wastes from sources throughout its tributary drainage area. Pollution occurs when waste discharges cause water quality conditions that damage or destroy varied uses of the Bay. Such conditions can result from toxic (poisonous) substances, from residues that unduly stimulate organic growth in the Bay, and from sewage that consumes oxygen in the water as it disintegrates. Polluted waters may be unsafe for human contact or use, offensive to the senses, damaging or lethal to marine life, and even unsuitable for industrial use.

The staff suggests that Finding "a." be changed as follows:

> a. San Francisco Bay receives a variety of wastes from numerous sources throughout its tributary drainage area. These include industrial and municipal waste, urban and agricultural surface runoff, sedimentation from upland erosion, vessel wastes, oil and chemical spills, and leachate from landfills and toxic dumps. Pollution occurs when waste discharges unreasonably interfere with, damage, or destroy one or more of the beneficial uses of the waters of the Bay. Pollutants include substances that are toxic, that unduly stimulate organic growth in the Bay, or that deplete

dissolved oxygen. Polluted waters may be offensive to the senses, unsafe for human contact or use, damaging or lethal to aquatic life, or unsuitable for industrial use.

2. Finding "b." This finding (page 8) presently states:

> b. Compared to rivers and estuaries in other parts of the country, San Francisco Bay is relatively unpolluted. In recent years, extensive improvements in the treatment of industrial and municipal wastes have greatly reduced the pollution that once existed in the Bay. But some parts, especially in the South Bay, are still polluted at certain times of the year. As long as the Bay continues to receive wastes from an expanding population and industry, there must be constant improvement in waste management to upgrade presently polluted areas and prevent pollution problems in the future.

The staff believes that Finding "b." should be replaced with the following new finding:

> b. Pollution from past waste discharges resulted in harm to fish and wildlife and the Bay's beneficial uses. Implementation of state and federal water pollution control programs by public agencies, particularly the federal Environmental Protection Agency, the State Water Resources Control Board, and the San Francisco Bay Regional Water Quality Control Board, have decreased significantly the pollutant levels in waste discharges to the Bay, resulting in dramatic improvements in the quality of Bay waters. However, water pollution still impairs Bay water

quality and the beneficial uses of the Bay. Of particular concern is the potential for cumulative long-term effects on the Bay from toxic pollutants. Water quality varies significantly within the Bay due to the pattern of waste discharges and the varying capability of the Bay to disperse, flush, and assimilate pollutants. Certain localized areas are seriously polluted with toxic substances. Additionally, toxic disposal sites on the shoreline threaten both Bay water quality and the development and use of certain areas of the shoreline by the public.

3. Finding "c." This finding (page 8) presently states:

> c. While waste disposal poses a continuing threat to water quality in the Bay, this use of Bay waters will continue for some time. Pollution of Bay waters from these wastes can be prevented by: (1) transporting waste directly to the ocean, (but without allowing waste discharges to damage the ocean's marine life); (2) prohibiting the discharge into the Bay of toxic wastes (poisons) that do not breakdown; (3) adequate treatment of wastes before discharge into the Bay; and (4) natural breakdown of any biodegradable wastes placed in the Bay, which can be encouraged by maintaining adequate flushing action and an adequate supply of dissolved oxygen in the Bay."

The staff believes that Finding "c." should be replaced by the following new finding:

c. Many strategies can be used to reduce the discharge of pollutants to the Bay, including: (1) assuring adequate treatment of wastes discharged to the Bay and its tributaries in compliance with standards set by the

State Water Resources Control Board, Regional Water Quality Control Board, and the federal Environmental Protection Agency; (2) directing treated waste discharges to the ocean (after assuring that the marine environment will be protected); (3) eliminating discharge of toxic substances into the Bay; (4) cleaning up existing toxic sites in the Bay, on the shoreline, or in upland areas that drain into the Bay; and (5) preventing increased sedimentation of the Bay by controlling upland soil erosion, particularly during the land development process.

4. Finding "d." This finding (page 8) now states:

> d. Key elements that affect flushing and the supply of dissolved oxygen are (1) the volume of water flowing in and out with the tides (and fresh water flowing into the Bay), (2) the temperature of Bay waters, and (3) the rates of oxygen interchange at the surface of the Bay, including the tidal flats.

The staff suggests that Finding "d." be changed as follows:

d. The harmful effects of pollutants reaching the Bay can be reduced by maximizing its capacity to assimilate and disperse pollutants. Key elements that affect the Bay's natural capacity to assimilate and disperse and flush wastes are: (1) the volume and circulation of water flowing in and out with the tides in from the;

Delta; (2) the rate of oxygen interchange at the surface of the Bay; and (3) the extent and distribution of tidal marshes.

5. Finding "e." This finding (page 8) now states:

> e. Several governmental programs are now seeking to determine the best methods of controlling water quality and preventing water pollution in the Bay. The San Francisco Bay Regional Water Quality Control Board has set water quality limits and time schedules for treatment facilities, so as to protect and enhance designated beneficial water uses of the Bay. The State's Bay-Delta Water Quality Control Program presented in 1969 its long-range plan to preventing Bay pollution. And the State Water Resources Control Board is studying the California laws on water quality control to determine whether they should be strengthened.

The staff suggests that Finding "e." be changed as follows:

> e. The State Water Resources Control Board is responsible for formulating and adopting state policy for water quality control pursuant to the state Porter-Cologne Water Quality Control Act and the federal Clean Water Act. The State Board is responsible for approving the water quality control plans of the nine regional water quality control boards, and establishing salinity standards for the Bay and Delta to protect the beneficial uses of these waters. The San Francisco Bay Regional Water Quality Control Board is charged with designating, protecting, and enhancing the beneficial uses of the waters of the San Francisco Bay Basin. The Regional Board states the

beneficial uses of the Bay waters and the water quality objectives and waste discharge standards in its Water Quality Control Plan, San Francisco Bay Basin, which it carries out through adoption and enforcement of waste discharge requirements and certification of Army Corps of Engineers' permits.

6. Policy "1." Policy 1. (page 8) now states:

> 1. To the greatest extent feasible, the remaining marshes and mudflats around the Bay, the remaining water volume and surface area of the Bay, and fresh water inflow into the Bay should be maintained.

The staff believes that this policy should be changed to read as follows:

> 1. To the greatest extent feasible, the Bay marshes, mudflats, and water surface area and volume should be maintained and whenever possible, increased. Fresh water inflow into the Bay should be maintained at a level adequate to protect Bay resources and beneficial uses.

7. Policies "2" and "3." These policies now read as follows:

> 2. Water quality in all parts of the Bay should be sufficiently high to permit water contact sports and to provide a suitable habitat for all indigenous and desirable forms of aquatic life. It is assumed that this will be achieved, in time, as the result of measures taken in response to requirements and enforcement proceedings of the Regional Water Quality

Control Board, and measures resulting from current government studies. (Because of the work of these agencies, this Commission has not dealt extensively with the problem of pollution control. But the entire Bay Plan is founded on the belief that water quality in San Francisco Bay can and will be maintained at levels sufficiently high to permit full public enjoyment and use of the Bay.)

3. The water quality laws and practices should insure that no project is built within the watershed of San Francisco Bay unless its liquid wastes will be treated, on the premises or in a public treatment plant having sufficient capacity, so that the effluent would not cause delay in compliance with applicable water quality standards anywhere in the Bay.

The staff believes that Policies "2" and "3" should be combined and revised into a new policy "2" that reads as follows:

2. Water quality in all parts of the Bay should be maintained at a level that will support and promote the beneficial uses of the Bay as identified in the Regional Water Quality Control Board's Basin Plan. The policies, recommendations, decisions, and authoritiy of the State Water Resources Control Board and the Control Board should be the basis for the Commission carrying out its water quality responsibilities.

8. New Policy "3." The staff believes that a new policy should be added that addresses soil erosion as follows:

3. Shoreline projects should be designed and constructed in a manner that reduces soil erosion and

protects the Bay from increased sedimentation through the use of appropriate erosion control practices.

9. New Policy 4. The staff believes that a new policy that addresses polluted runoff from Commission projects should be added as follows:

> 4. Polluted runoff from shoreline projects should be controlled by requiring compliance with best pollution control management practices in order to protect the water quality and beneficial uses of the Bay, especially where water dispersion is poor and near shellfish beds and other significant biotic resources. Whenever possible, runoff discharge points should be located where the discharge will have the least impact. Approval of projects involving shoreline areas polluted with hazardous substances should be conditioned so that they will not cause harm to the public or the beneficial uses of the Bay.

Summary of Major Conclusion and Policies

The Summary section of the Bay Plan (pp. 1-3) contains a major statement concerning the Commission's conclusions and policies on water quality (page 2) that now reads:

> 7. **Water Quality.** Liquid wastes from many municipal, industrial, and agricultural sources are emptied into San Francisco Bay. Because of the work now underway by the San Francisco Bay Regional Water Quality Control Board, the Army

Corps of Engineers, and the Bay-Delta Water Quality Control Program, the Bay Plan does not deal extensively with the problems of pollution control. But the entire Bay Plan is founded on the belief that water quality in San Francisco Bay can and will be maintained at levels sufficiently high to permit full public enjoyment and use of the Bay.

The staff believes that Major Conclusion and Policies statement concerning water quality should be revised as follows:

7. Water Quality. San Francisco Bay receives wastes from many municipal, industrial, and agricultural sources. Because of the regulatory authority of the State Water Resources Control Board, the San Francisco Bay Regional Water Quality Control Board, the federal Environmental Protection Agency, and the Army Corps of Engineers, the Bay Plan does not deal extensively with the problems and means of pollution control. Nevertheless, the entire Bay Plan is founded on the belief that water quality in San Francisco Bay can and will be maintained at levels sufficiently high to protect the beneficial uses of the Bay.

Recreation

The staff believes that the following changes should be made to the Recreation findings and policies (pp. 21-22) to address vessel wastewater quality concerns.

1. Finding "d." The following underlined language should be added to existing finding "d." (page 21) concerning recreational boat marinas:

> d. Boating allows residents to take advantage of the unique recreational opportunities provided by the Bay. As of July, 1981, the Commission had authorized approximately 6,500 new berths, bringing the regional total to approximately 19,200 berths. Additional berths and launchng ramps will be needed in the future. Some locations are unsuitable for marinas or launching facilities because of high rates of sedimentation, valuable habitat, and insufficient upland for support facilities. An adequate number of conveniently located restrooms and vessel sewage pump-out facilities at recreational boat marinas will assist significantly in reducing wastewater discharges from vessels.

2. Policy "4. b." The staff further believes that the underlined language should be added to existing policy 4.b. (page 21) concerning recreational boat marinas:

> b. Marinas. (1) Marinas should be allowed at any suitable site on the Bay. Unsuitable sites are those that tend to fill up rapidly with sediment; have insufficient upland; contain valuable marsh, mudflat, or other wildlife habitat; or are subject to unusual

amounts of fog. At suitable sites, the Commission should encourage new marinas, particularly those that result in the creation of new open water through the excavation of areas not part of the Bay and not containing valuable wetlands. (2) Fill should be permitted for marina facilities that must be in or over the Bay, such as breakwaters, shoreline protection, berths, ramps, launching facilities, pump-out and fuel docks, and short-term unloading areas. Fill for marina support facilities may be permitted at sites with difficult land configurations provided that the fill in the Bay is the minimum necessary and any unavoidable loss of Bay habitat, surface area, or volume is offset to the maximum amount feasible, preferably at or near the site. (3) No new marina or expansion of any existing marina should be approved unless water quality and circulation will be adequately protected and, if possible, improved, and an adequate number of vessel sewage pump-out facilities that are convenient in location and time of operation to recreational boat users will be provided free of charge or at a reasonable fee, as well as receptacles to dispose of waste oil. (4) In addition, all projects approved should provide public amenities such as viewing areas, restrooms, and public parking; substantial physical and visual access; and maintenance for all facilities. Frequent dredging should be avoided.

Dredging

The staff believes that the following findings and policies addressing the water quality aspects of dredging should be added to the dredging findings and policies of the Bay Plan.

1. New Findings "f.", "g", and "h." The following new findings should be added to the Bay Plan Dredging findings (pp 15-16) as follows:

f. Past and present waste disposal practices have resulted in the introduction of pollutants into the Bay, some of which have degraded Bay sediments. These pollutants are not distributed evenly in the Bay and localized areas are highly contaminated.

g. Dredging and subsequent Bay disposal of contaminated sediments can resuspend pollutants or make them accessible to Bay organisms, resulting in possible adverse impacts on the beneficial uses of the Bay.

h. The Regional Water Quality Control Board and the Environmental Protection Agency are responsible for determining what testing is appropriate and for assuring that dredging and spoils disposal are consistent with the maintenance of water quality in the Bay.

2. New Policy 7. The following new policy should be added to the Bay Plan Dredging policies (pp 15-16) as follows:

> 7. Prior to authorization of dredging or the disposal of spoils in the Bay, the Commission should assure that adequate testing of the sediments will be done and that the sediments will be dredged and disposed of consistent with the requirements of the Regional Water Quality Control Board and the Environmental Protection Agency.

CHAPTER V. ADOPTED BAY PLAN AMENDMENT

On March 19, 1987 the Commission adopted Bay Plan amendment 4-86 to the San Francisco Bay Plan that involves changes to: (1) the water quality portion of the Summary section of the Bay Plan, (2) the title of the Water Pollution section, and (3) the findings and policies of the Bay Plan sections on Water Pollution, Recreation, and Dredging as indicated below.

Changes to Major Conclusions and Policies

The underlined language is added to and the lined out language deleted from the Water Quality section (page 2) of Part I Summary, Major Conclusions and Policies (pages 1-3):

7. **Water Quality.** ~~Liquid wastes from many municipal, industrial, and agricultural sources are emptied into San Francisco Bay. Because of the work now underway by the San Francisco Bay Regional Water Quality Control Board, the Army Corps of Engineers, and the Bay-Delta Water Quality Control Program, the Bay Plan does not deal extensively with the problems of pollution control. But the entire Bay Plan is founded on the belief that water quality in San Francisco Bay can and will be maintained at levels sufficiently high to permit full public enjoyment and use of the Bay.~~

   San Francisco Bay receives wastes from many municipal, industrial, and agricultural sources. Because of the regulatory authority of the State Water Resources Control Board, the San Francisco Bay Regional Water Quality Control Board, the federal Environmental Protection Agency, and the Army Corps of Engineers, the Bay Plan does not deal extensively with the problems and means of pollution control. Nevertheless, the entire Bay Plan is founded on the belief that water quality in San Francisco Bay can and will be maintained at levels sufficiently high to protect the beneficial uses of the Bay.

Changes to Water Pollution Findings and Policies

1. Section Title. The underlined language is added to and the lined out language deleted from the title of the water pollution section (page 8):

WATER ~~POLLUTION~~ QUALITY
Findings and policies concerning
Water ~~Pollution~~ Quality in the Bay

2. Findings. The underlined language is added to and the lined out language deleted from the existing Water Pollution findings (page 8):

a. ~~San Francisco Bay receives a variety of municipal, industrial, and agricultural wastes from sources throughout its tributary drainage area. Pollution occurs when waste discharges cause water quality conditions that damage or destroy varied uses of the Bay. Such conditions can result from toxic (poisonous) substances, from residues that unduly stimulate organic growth in the Bay, and from sewage that consumes oxygen in the water as it disintegrates. Polluted waters may be unsafe for human contact or use, offensive to the senses, damaging or lethal to marine life, and even unsuitable for industrial use.~~

San Francisco Bay receives a variety of wastes from numerous sources throughout its tributary drainage area. These include industrial and municipal waste, urban and agricultural surface runoff, sedimentation from upland erosion, vessel wastes, oil and chemical spills, and leachate from landfills and toxic dumps. Pollution occurs when waste discharges unreasonably interfere with, damage, or destroy one or more of the beneficial uses of the waters of the Bay. Pollutants include substances that are toxic, that unduly stimulate organic growth in the Bay, or that deplete dissolved oxygen. Polluted waters may be offensive to the senses, unsafe for human contact or use, damaging or lethal to aquatic life, or unsuitable for industrial use.

b. ~~Compared to rivers and estuaries in other parts of the country, San Francisco Bay is relatively unpolluted. In recent years, extensive improvements in the treatment of industrial and municipal wastes have greatly reduced the pollution that once existed in the Bay. But some parts, especially in the South Bay, are still polluted at certain times of the year. As long as~~

~~the Bay continues to receive wastes from an expanding population and industry, there must be constant improvement in waste management to upgrade presently polluted areas and prevent pollution problems in the future.~~

Pollution from past waste discharges resulted in harm to fish and wildlife and the Bay's beneficial uses. Implementation of state and federal water pollution control programs by public agencies, particularly the federal Environmental Protection Agency, the State Water Resources Control Board, and the San Francisco Bay Regional Water Quality Control Board, have decreased significantly the pollutant levels in waste discharges to the Bay, resulting in dramatic improvements in the quality of Bay waters. However, water pollution still impairs Bay water quality and the beneficial uses of the Bay. Of particular concern is the potential for cumulative long-term effects on the Bay from toxic pollutants. Water quality varies significantly within the Bay due to the pattern of waste discharges and the varying capability of the Bay to disperse, flush, and assimilate pollutants. Certain localized areas are seriously polluted with toxic substances. Additionally, toxic disposal sites on the shoreline threaten both Bay water quality and the development and use of certain areas of the shoreline by the public.

c. ~~While waste disposal poses a continuing threat to water quality in the Bay, this use of Bay waters will continue for some time. Pollution of Bay waters from these wastes can be prevented by: (1) transporting waste directly to the ocean, (but without allowing waste discharges to damage the ocean's marine life); (2) prohibiting the discharge into the Bay of toxic wastes (poisons) that do not break down; (3) adequate treatment of wastes before discharge into the Bay; and (4) natural breakdown of any biodegradable wastes placed in the Bay, which can be encouraged by maintaining adequate flushing action and an adequate supply of dissolved oxygen in the Bay.~~

Many strategies can be used to reduce the discharge of pollutants to the Bay, including: (1) assuring adequate treatment of wastes discharged to the Bay and its tributaries in compliance with standards set by the State Water Resources Control Board, Regional Water Quality Control Board, and the federal Environmental

Protection Agency; (2) directing treated waste discharges to the ocean (after assuring that the marine environment will be protected); (3) eliminating discharge of toxic substances into the Bay; (4) cleaning up existing toxic sites in the Bay, on the shoreline, or in upland areas that drain into the Bay; and (5) preventing increased sedimentation of the Bay by controlling upland soil erosion, particularly during the land development process.

d. ~~Key elements that affect flushing and the supply of dissolved oxygen are (1) the volume of water flowing in and out with the tides (and fresh water flowing into the Bay), (2) the temperature of Bay waters, and (3) the rates of oxygen interchange at the surface of the Bay, including the tidal flats.~~

The harmful effects of pollutants reaching the Bay can be reduced by maximizing its capacity to assimilate, disperse, and flush pollutants. Key elements that affect the Bay's natural capacity to assimilate, disperse, and flush wastes are: (1) the volume and circulation of water flowing in and out with the tides and in freshwater inflow (2) the rate of oxygen interchange at the surface of the Bay; and (3) the extent and distribution of tidal marshes.

e. ~~Several governmental programs are now seeking to determine the best methods of controlling water quality and preventing water pollution in the Bay. The San Francisco Bay Regional Water Quality Control Board has set water quality limits and time schedules for treatment facilities, so as to protect and enhance designated beneficial water uses of the Bay. The State's Bay-Delta Water Quality Control Program presented in 1969 its long-range plan to preventing Bay pollution. And the State Water Resources Control Board is studying the California laws on water quality control to determine whether they should be strengthened.~~

The State Water Resources Control Board is responsible for formulating and adopting state policy for water quality control pursuant to the state Porter-Cologne Water Quality Control Act and the federal Clean Water Act. The State Board is responsible for approving the water quality control plans of the nine regional water quality control boards, and establishing salinity

standards for the Bay and Delta to protect the beneficial uses of these waters. The San Francisco Bay Regional Water Quality Control Board is charged with designating, protecting, and enhancing the beneficial uses of the waters of the San Francisco Bay Basin. The Regional Board states the beneficial uses of the Bay waters and the water quality objectives and waste discharge standards in its Water Quality Control Plan, San Francisco Bay Basin, which it carries out through adoption and enforcement of waste discharge requirements and certification of Army Corps of Engineers'permits.

3. Policies. The underlined language is added to and the lined out language deleted from the existing Water Pollution policies (page 8):

1. ~~To the greatest extent feasible, the remaining marshes and mudflats around the Bay, the remaining water volume and surface area of the Bay, and fresh water inflow into the Bay should be maintained.~~

   To the greatest extent feasible, the Bay marshes, mudflats, and water surface area and volume should be maintained and, whenever possible, increased. Fresh water inflow into the Bay should be maintained at a level adequate to protect Bay resources and beneficial uses. Bay water pollution should be avoided.

2. ~~Water quality in all parts of the Bay should be sufficiently high to permit water contact sports and to provide a suitable habitat for all indigenous and desirable forms of aquatic life. It is assumed that this will be achieved, in time, as the result of measures taken in response to requirements and enforcement proceedings of the Regional Water Quality Control Board, and measures resulting from current government studies. (Because of the work of these agencies, this Commission has not dealt extensively with the problem of pollution control. But the entire Bay Plan is founded on the belief that water quality in San Francisco Bay can and will be maintained at levels sufficiently high to permit full public enjoyment and use of the Bay.)~~

   Water quality in all parts of the Bay should be maintained at a level that will support and promote the beneficial uses of the Bay as identified in the Regional Water Quality Control

Board's Basin Plan. The policies, recommendations, decisions, advice and authority of the State Water Resources Control Board and the Regional Water Quality Control Board, should be the basis for carrying out the Commission's water quality responsibilities.

3. ~~The water quality laws and practices should insure that no project is built within the watershed of San Francisco Bay unless its liquid wastes will be treated, on the premises or in a public treatment plant having sufficient capacity, so that the effluent would not cause delay in compliance with applicable water quality standards anywhere in the Bay.~~

Shoreline projects should be designed and constructed in a manner that reduces soil erosion and protects the Bay from increased sedimentation through the use of appropriate erosion control practices.

4. Polluted runoff from projects should be controlled by the use of best management practices in order to protect the water quality and beneficial uses of the Bay, especially where water dispersion is poor and near shellfish beds and other significant biotic resources. Whenever possible, runoff discharge points should be located where the discharge will have the least impact. Approval of projects involving shoreline areas polluted with hazardous substances should be conditioned so that they will not cause harm to the public or the beneficial uses of the Bay.

Changes to Recreation Findings and Policies

1. Findings. The underlined language is added to the existing Recreation findings (page 21):

d. Boating allows residents to take advantage of the unique recreational opportunities provided by the Bay. As of July, 1981, the Commission had authorized approximately 6,500 new berths, bringing the regional total to approximately 19,200 berths. Additional berths and launching ramps will be needed in the future. Some locations are unsuitable for marinas or launching facilities because of high rates of sedimentation, valuable habitat, and insufficient upland for support facilities. An adequate number of conveniently located restrooms and vessel sewage

pump-out facilities at recreational boat marinas will assist significantly in reducing wastewater discharges from vessels.

2. Policies. The underlined language is added to the existing Recreation policies (pages 21-22):

4.b. **Marinas.** (1) Marinas should be allowed at any suitable site on the Bay. Unsuitable sites are those that tend to fill up rapidly with sediment; have insufficient upland; contain valuable marsh, mudflat, or other wildlife habitat; or are subject to unusual amounts of fog. At suitable sites, the Commission should encourage new marinas, particularly those that result in the creation of new open water through the excavation of areas not part of the Bay and not containing valuable wetlands. (2) Fill should be permitted for marina facilities that must be in or over the Bay, such as breakwaters, shoreline protection, berths, ramps, launching facilities, pump-out and fuel docks, and short-term unloading areas. Fill for marina support facilities may be permitted at sites with difficult land configurations provided that the fill in the Bay is the minimum necessary and any unavoidable loss of Bay habitat, surface area, or volume is offset to the maximum amount feasible, preferably at or near the site. (3) No new marina or expansion of any existing marina should be approved unless water quality and circulation will be adequately protected and, if possible, improved, and an adequate number of vessel sewage pumpout facilities that are convenient in location and time of operation to recreational boat users should be provided free of charge or at a reasonable fee, as well as receptacles to dispose of waste oil. (4) In addition, all projects approved should provide public amenities such as viewing areas, restrooms, and public parking; substantial physical and visual access; and maintenance for all facilities. Frequent dredging should be avoided.

Changes to Dredging Findings and Policies

1. Findings. The underlined language is added to the existing Dredging findings (page 15):

f. Past and present waste disposal practices have resulted in the introduction of pollutants into the Bay, some of which have degraded Bay sediments. These pollutants are not distributed evenly in the Bay and localized areas are highly contaminated.

g. Dredging and subsequent Bay disposal of contaminated sediments can resuspend pollutants or make them accessible to Bay organisms, resulting in possible adverse impacts on the beneficial uses of the Bay.

h. The Regional Water Quality Control Board and the Environmental Protection Agency are responsible for determining what testing is appropriate and for assuring that dredging and materials disposal are consistent with the maintenance of water quality in the Bay.

2. Policies. The underlined language is added to the existing Dredging policies (page 15-16):

7. Prior to authorization of dredging or the disposal of dredged materials in the Bay, the Commission should assure that adequate testing of the sediments will be done and that the sediments will be dredged and disposed of consistent with the requirements of the Regional Water Quality Control Board and the Environmental Protection Agency.

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Donald Anderson, August 1986. Testimony before subcommittee on water and power resources house interior and insular affairs committee.

CHAPTER III

1. United States of America, et al., v. State Water Resources Control Board, AO 27690 and AO 30014 (Cal. Ct. App.), May 28, 1986.

CHAPTER IV

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2. BCDC Permit No. M85-69

3. BCDC Permit No. 8-77

4. BCDC Permit No. M86-66

5. BCDC Permit No. 14-76

6. Stenstrom, M. K., G. Silverman, T. A. Bursztynsky, et al, 1982. Oil and Grease in Stormwater Runoff. Association of Bay Area Governments, Oakland, CA, 241p.

24. Personal Communication, 1986, Dick Whitsel, San Francisco Regional Water Quality Control Board

25. California Regional Water Quality Control Board, San Francisco Bay Region, August 29, 1986. Internal Memo on Dredge Review Policy.

26. California Regional Water Quality Control Board, San Francisco Bay Region, November 14, 1986. Final Draft: 1986 Water Quality Control Plan Amendments.

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APPENDIX A
LOCATIONS OF TOXIC SITES NEAR THE SAN FRANCISCO BAY

State Superfund Sites in Proximity to San Francisco Bay

These sites identified by number and a "●" symbol on the maps that follow. State Superfund sites identified by a "O" symbol have been remediated.*

1 - Electro-Coating
2 - F.M.C.
3 - Leslie Salt
4 - Clorox Co.
5 - Port of Oakland
6 - Bray Oil/Burmah Castrol
7 - Cooper Chemical Co.
8 - Drew Sales
9 - Hercules Properties
10 - Point Isabel
11 - Richmond Plating
12 - Summer Chemical
13 - Chevron Chemical/Ortho Division
14 - Point Pinole/Bethlehem Steel
15 - Liquid Gold**
16 - Chevron Refinery
17 - Levin Metals/United Heckathorn
18 - Wickland Oil/Selby Slag Pile
19 - Koppers Co.
20 - Bay Area Drum
21 - Healy Tibbits
22 - Zoecon**
23 - Alviso**

*Remediated sites may retain toxicants that have been contained on-site,
**Also on Federal Superfund List

Source: State Department of Health Services

Federal Sites in Proximity to San Francisco Bay

These sites identified by number and a "■" symbol on the maps that follow.

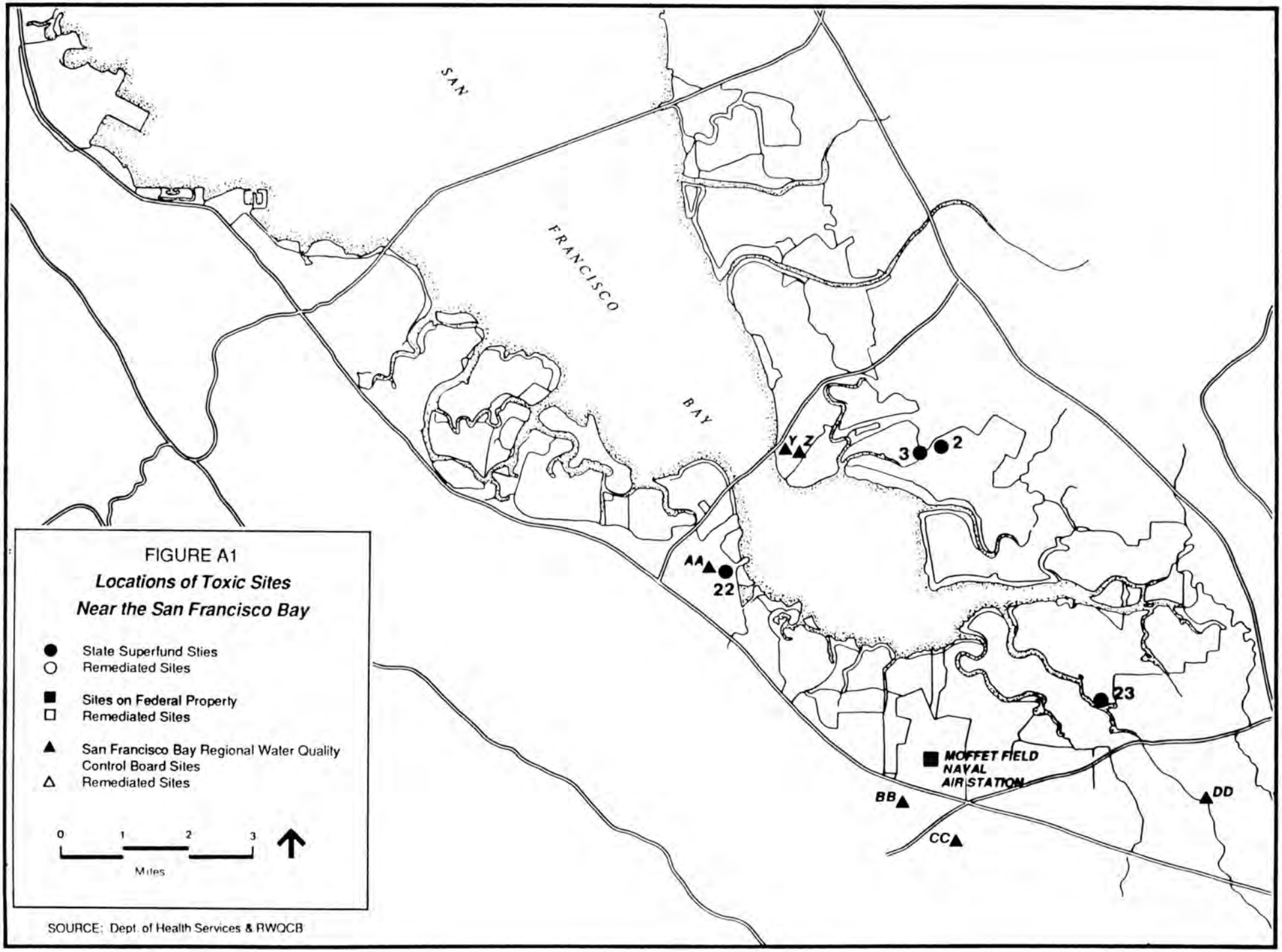
1 - Moffet Field Naval Air Station
2 - Alameda Naval Air Station
3 - Hunters Point
4 - Ozol Terminal
5 - Concord Naval Weapon Station

Sites Under Investigation by the San Francisco Bay Regional Water Quality Control Board As Threats to Bay Water Quality

These sites identified by letter and a "▲" symbol on the maps that follow.

A - Witco U. S. Peroxygen
B - Broadway Project
C - Wiegmann Rose
D - F.M.C
E - Georgia Pacific
F - Bonner Brothers
G - Fass Metal
H - Santa Fe Container Storage
I - Richmond Ferry Point
J - Richmond Marina
K - Cal Cap
L - Curoco
M - Western Forge and Flange
N - De Soto
O - Westinghouse
P - Smilo Chemical
Q - King Petroleum
R - Union Chemical
S - Neptune Salvage
T - Crown Zellerbach
U - A. C. Transit
V - P. G. & E
W - Southern Pacific
X - Homart Development
Y - Ashland Chemical
Z - H. B. Fuller
AA - Cal Mac Transportation
BB - Groundwater Plumes from multiple sites
CC - Groundwater Plumes from multiple sites
DD - Foxburo
EE - Castro Cove

Source: San Francisco Bay Regional Water Quality Control Board


SAN
FRANCISCO
BAY
Y
Z
3
2
AA
22
23
MOFFET FIELD
NAVAL
AIR STATION
BB
CC
DD
FIGURE A1
Locations of Toxic Sites
Near the San Francisco Bay
State Superfund Sties
Remediated Sites
Sites on Federal Property
Remediated Sites
San Francisco Bay Regional Water Quality
Control Board Sites
Remediated Sites
0
1
2
3
Miles
SOURCE: Dept. of Health Services & RWQCB

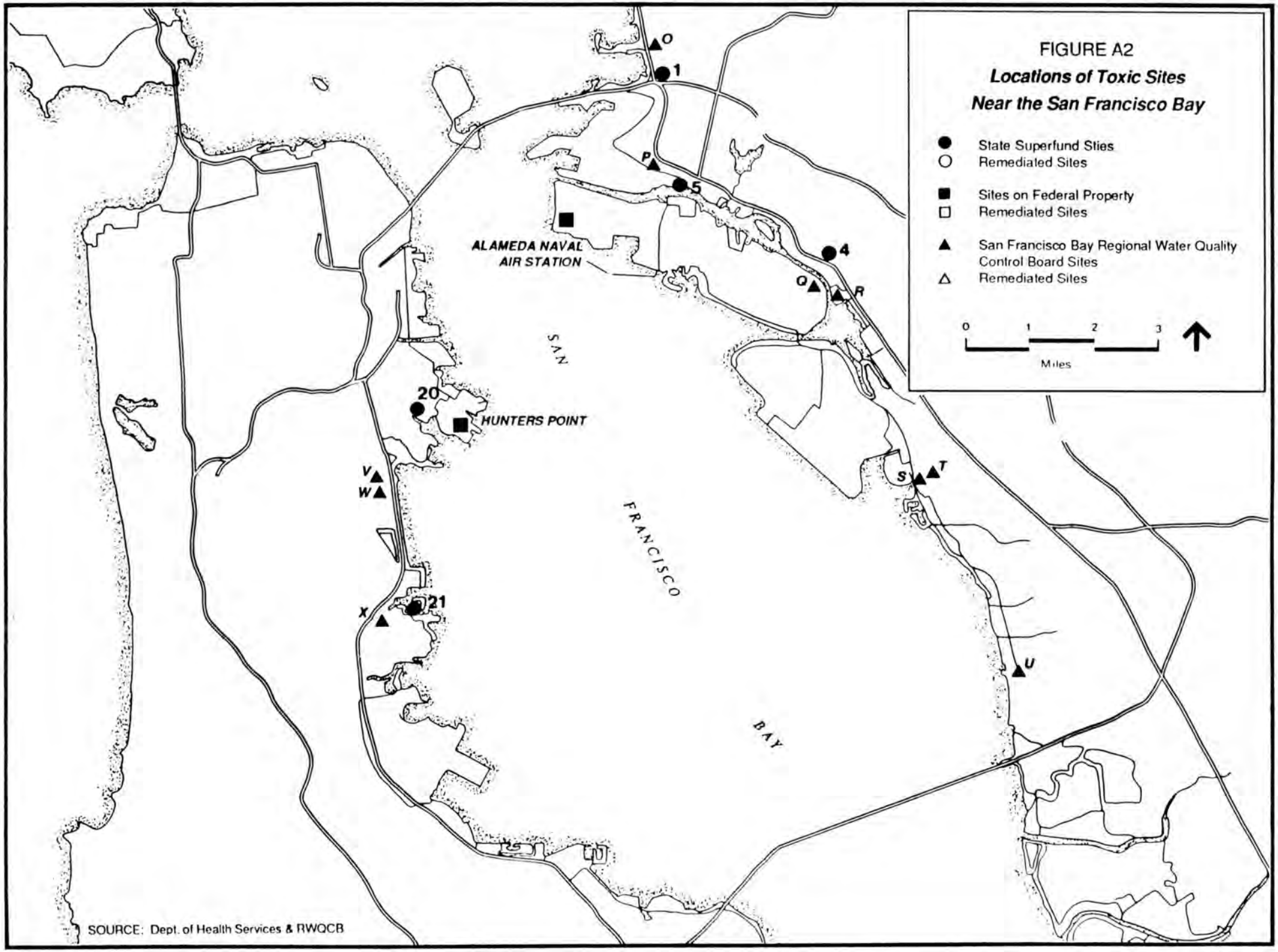


FIGURE A2
Locations of Toxic Sites
Near the San Francisco Bay
State Superfund Sties
Remediated Sites
Sites on Federal Property
Remediated Sites
San Francisco Bay Regional Water Quality Control Board Sites
Remediated Sites
0 1 2 3
Miles
ALAMEDA NAVAL AIR STATION
HUNTERS POINT
SAN FRANCISCO BAY
O
1
P
5
4
Q
R
20
V
W
X
21
S
T
U
SOURCE: Dept. of Health Services & RWQCB

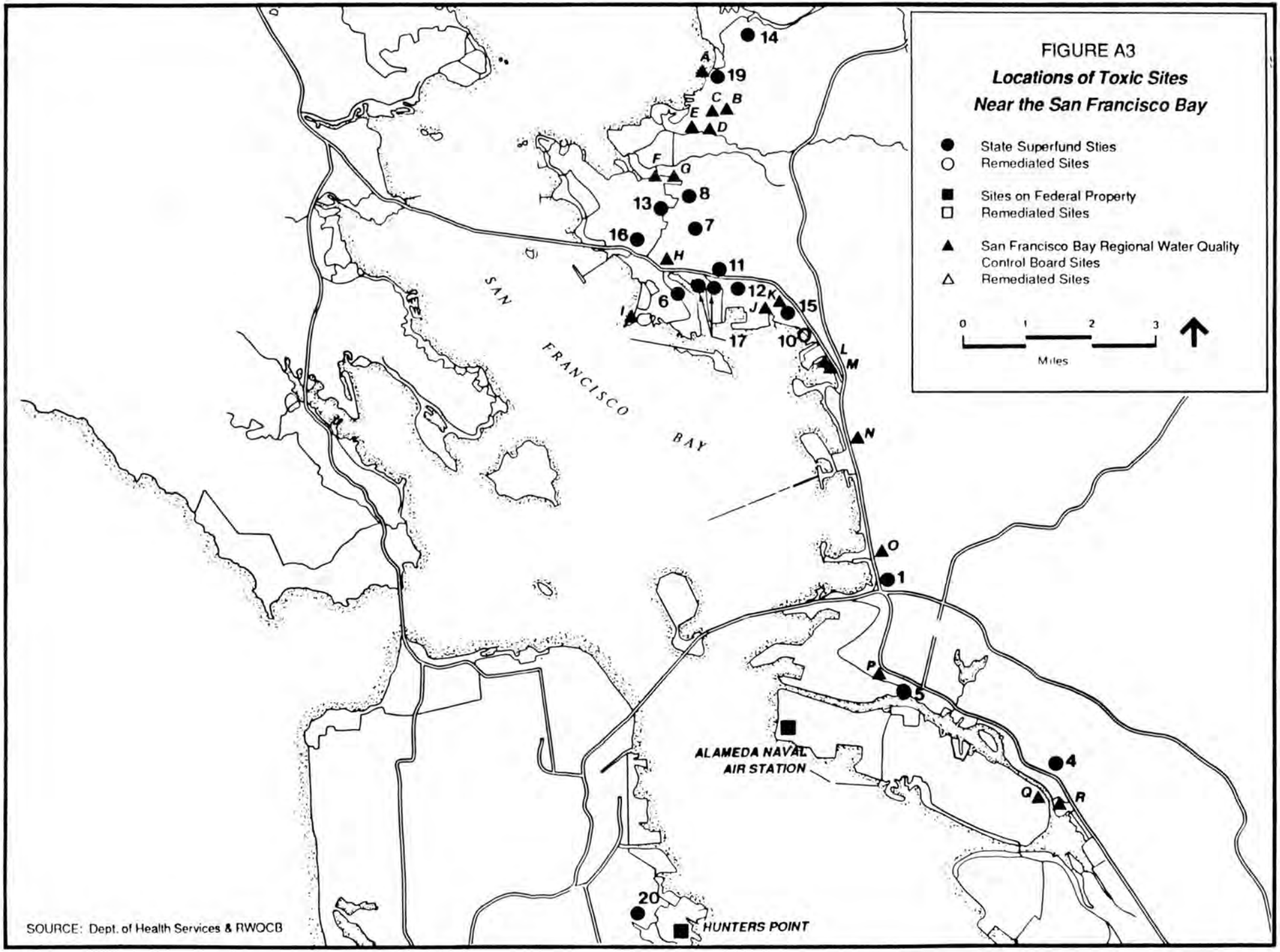


FIGURE A3
Locations of Toxic Sites
Near the San Francisco Bay
State Superfund Sties
Remediated Sites
Sites on Federal Property
Remediated Sites
San Francisco Bay Regional Water Quality Control Board Sites
Remediated Sites
0 1 2 3
Miles
SAN FRANCISCO BAY
ALAMEDA NAVAL AIR STATION
HUNTERS POINT
SOURCE: Dept. of Health Services & RWOCB

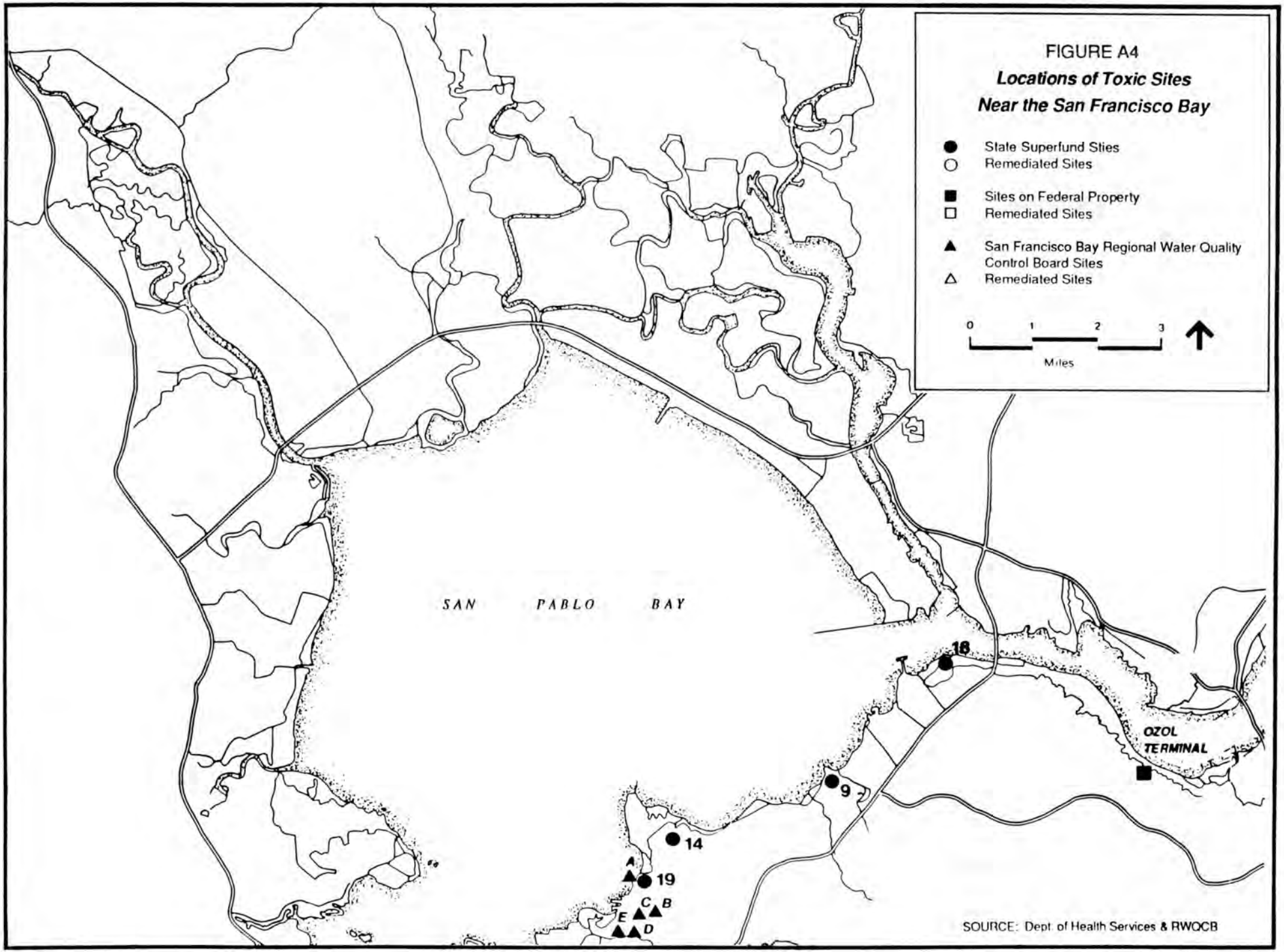


FIGURE A4
Locations of Toxic Sites
Near the San Francisco Bay
State Superfund Sties
Remediated Sites
Sites on Federal Property
Remediated Sites
San Francisco Bay Regional Water Quality Control Board Sites
Remediated Sites
0
1
2
3
Miles
SAN PABLO BAY
16
OZOL TERMINAL
9
14
A
19
C
B
E
D
SOURCE: Dept. of Health Services & RWQCB

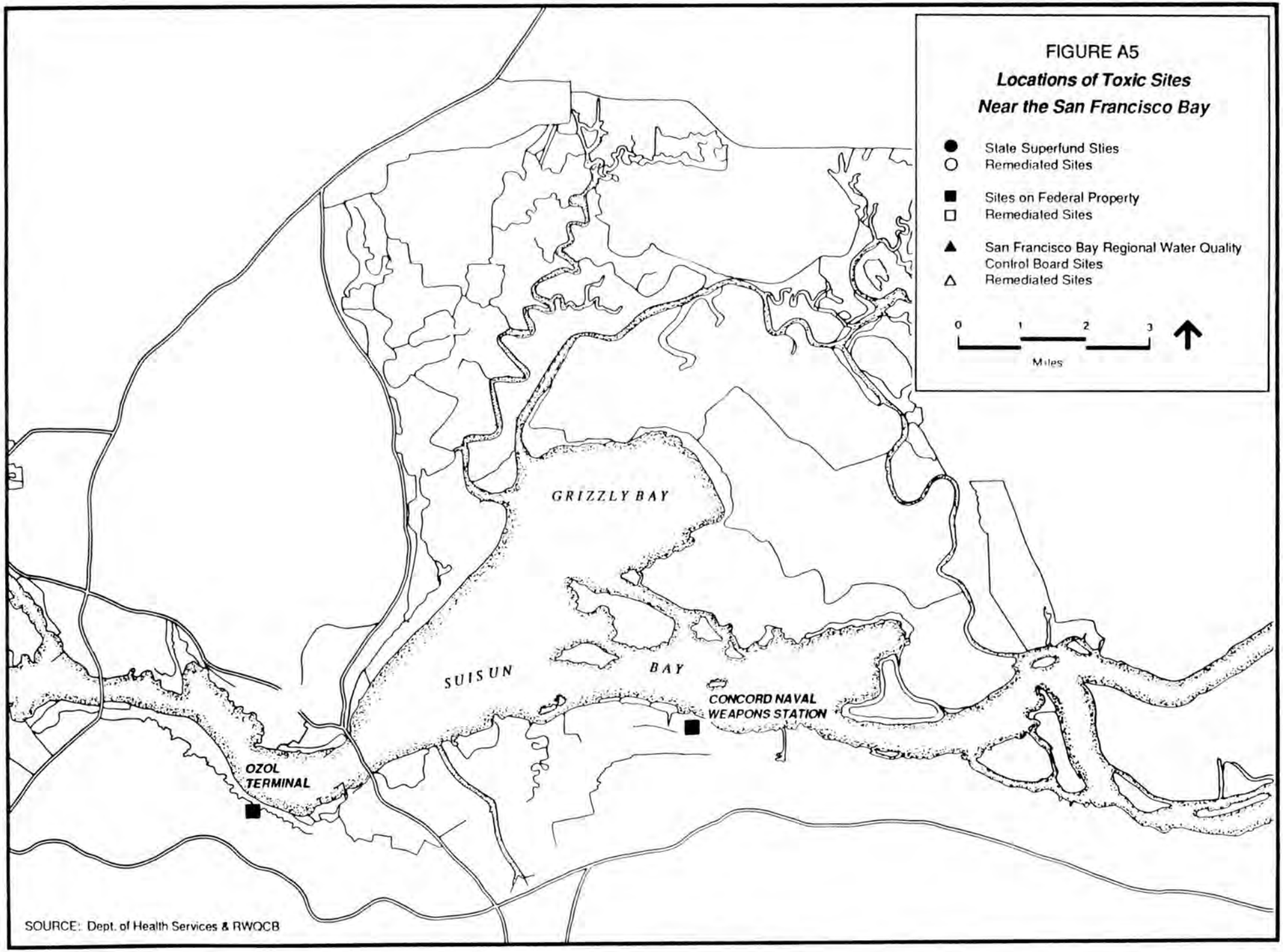


FIGURE A5
Locations of Toxic Sites
Near the San Francisco Bay
State Superfund Sties
Remediated Sites
Sites on Federal Property
Remediated Sites
San Francisco Bay Regional Water Quality
Control Board Sites
Remediated Sites
0
1
2
3
Miles
GRIZZLY BAY
SUISUN
BAY
CONCORD NAVAL
WEAPONS STATION
OZOL
TERMINAL
SOURCE: Dept. of Health Services & RWQCB

APPENDIX B
PERSONS AND AGENCIES CONTACTED IN PREPARATION OF THE REPORT

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Patrick Cotter, U. S. Environmental Protection Agency
Jeremy Johnstone, U. S. Environmental Protection Agency
William Robertson, U. S. Environmental Protection Agency
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Jeannette Whippel, National Marine Fisheries Service
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